COLLEGE OF ENG

the Cornell engineer

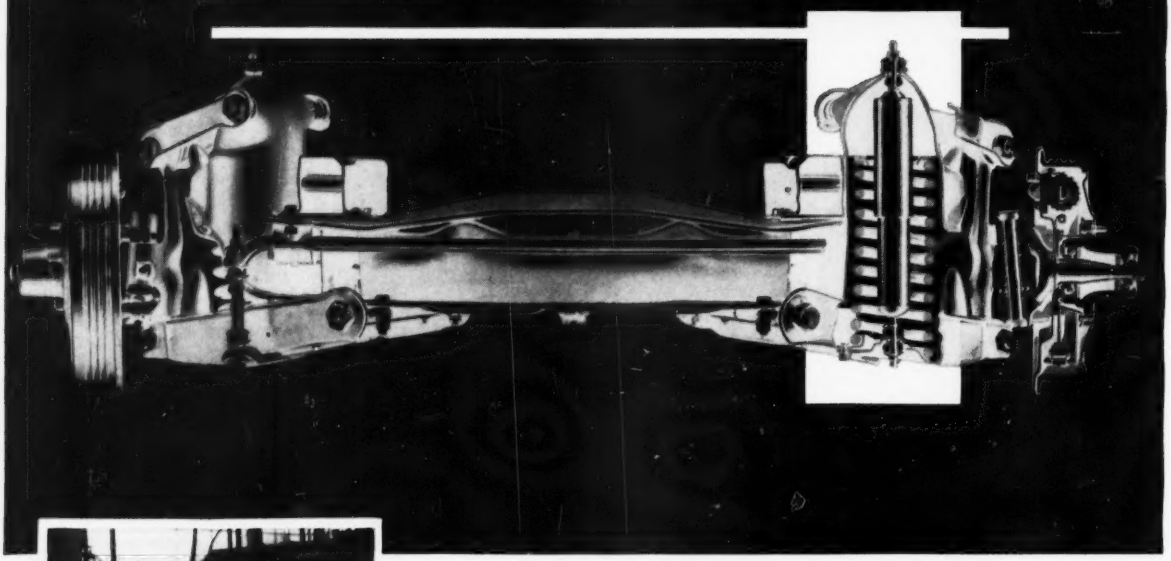
OCTOBER, 1953

VOL. 19, NO. 1

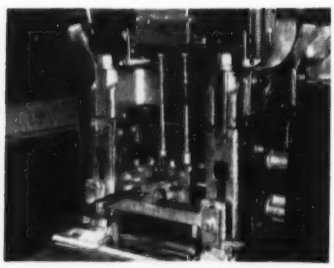
25 CENTS

We gambled on the future

and the auto industry cashed in



● Here, at Muehlhausen Spring Division of Standard Steel Spring Co., precision-rolled U S S CARILLOY Spring Rounds are coiled without centerless grinding. CARILLOY Rounds have minimum decarburization, and they cost less to use.



● At the Gary Works of United States Steel, this precision mill rolls CARILLOY Coil Spring Rounds with extreme accuracy. Tolerances are half of standard: .004" on the diameter, instead of the usual .008", and only .006" out of round, compared to .012" on ordinary rolled bars.

IN the early days of the development of coil springs for front suspensions of automobiles, the only steel that was available was an ordinary hot-rolled bar from which as much as .035" of metal per side had to be removed by grinding to insure freedom from harmful seams, pits, and decarburization. This cost money, was wasteful and time consuming.

We at United States Steel felt there was a better way of doing this, so we put our best engineers on the problem.

Using a mill especially equipped for the purpose, they devised an ingenious method of producing hot-rolled bars to eliminate harmful defects and most of the grinding expense. Rolled by this method to half the standard tolerances, with half or less the amount of decarburization, these CARILLOY Precision Rolled Coil Spring Rounds can be used "as furnished" or with only a small amount of centerless grinding.

This exclusive development has paid off in two ways. It has paid off for the automobile manufacturer in that his costs are reduced and spring performance is of the highest order. And it has paid off for us because these CARILLOY Precision Rolled Coil Spring Rounds are now used in over half of the coil springs in new automobiles.

Here's just one more example of the better steel products being developed by United States Steel's vast research program. To keep pace with the ever-increasing demand for special steel, United States Steel is always looking for young men with exceptional ability and training in metallurgy, engineering and related fields. For more information, write United States Steel Corporation, Room 2816-C, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

USS

3-1817

UNITED STATES STEEL

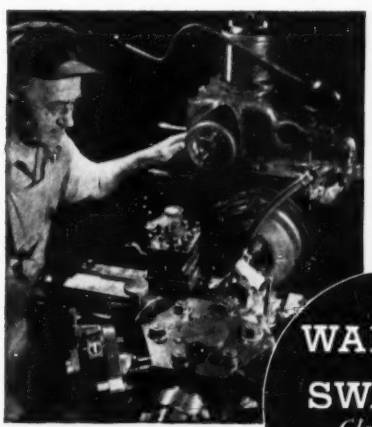
You can't vote yourself security

THE GERMANS TRIED IT and lost their nation —the Russians pretended to try it and made themselves slaves.

You'll notice that security is always offered in return for your vote—"just a vote of confidence, so I can get for you what you want." So the worker votes for a union boss he never saw, the businessman votes for a subsidy or cost-plus government contract.

And for every inch they advance toward security, they retreat a mile toward regulation that is next to servitude.

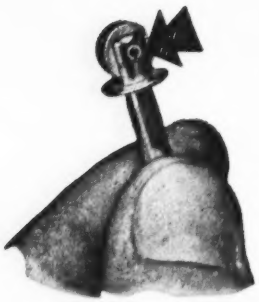
But there *is* a way to enjoy security in America (and only in America, by the way). That is, to make yourself something the world must have—a skillful farmer, a productive worker, a sound businessman. In this country it is true that the more value you add to the world and the more you add to the world's goods, the more you will be paid in return. *That* is security with self-respect —the only kind of security Americans want.



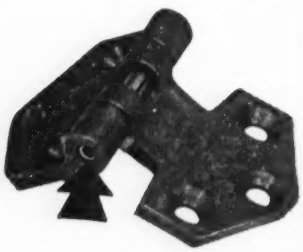
There are employment opportunities at Warner & Swasey for young men of ability and character who believe as firmly in the principles of Americanism as they do in the principles of sound engineering. Write Charles Ufford.

WARNER & SWASEY
Cleveland
PRECISION MACHINERY SINCE 1880

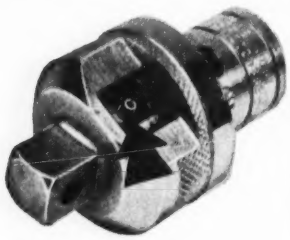
YOU CAN PRODUCE IT BETTER, FASTER, FOR LESS WITH WARNER & SWASEY MACHINE TOOLS, TEXTILE MACHINERY, CONSTRUCTION MACHINERY



Replacing a rivet

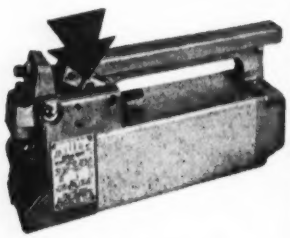


. . . a hinge pin



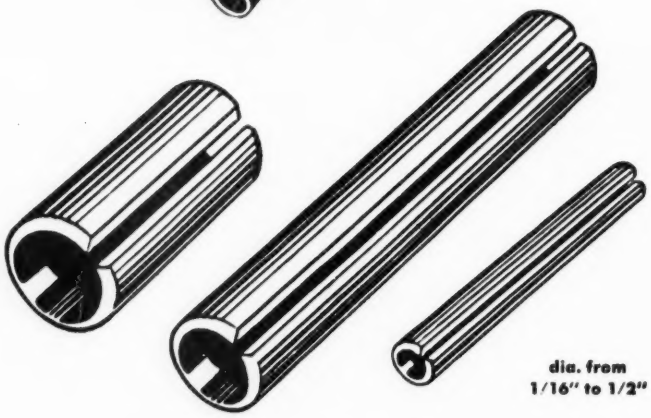
. . . a stop pin

. . . a set screw



. . . a bolt and nut

ROLLPIN



dia. from 1/16" to 1/2"

. . . a modern fastener that saves time and money on thousands of applications

Rollpin is a hollow, split, cylindrically formed pin with chamfered ends. It is simply driven into holes drilled to normal production tolerances. Because Rollpin is slightly larger than standard sized holes, it compresses as inserted. It is self-locking—and vibration-proof—because of the constant pressure it exerts against hole walls. Its shear strength exceeds that of a cold rolled pin of the same diameter. Rollpin is readily removed with a drift or pin punch—and can be reused.

Because of its versatility—and the production economies it makes possible—Rollpin is finding wide usage in almost every phase of manufacturing activity. Write for design information on the Rollpin. It will enable you to cut costs for many applications where use of rivets, set screws, dowels, and straight, serrated or cotter type pins create installation or performance problems.

ELASTIC STOP NUT CORPORATION OF AMERICA

2330 Vauxhall Road, Union, New Jersey

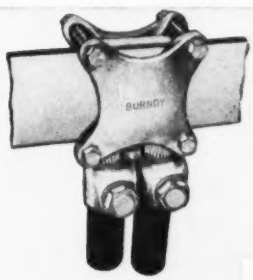
Elastic Stop Nuts with the famous red collar are another ESNA product

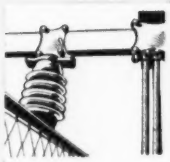
ESNA

PROBLEM: To join or terminate any electrical conductor—anywhere

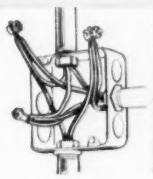
SOLUTION: BURNDY CONNECTORS

Wherever electrical conductors are joined, terminated, clamped or grounded —you'll find Burndy connectors completing the circuit . . . safeguarding the circuit. Right down the line, from mammoth industrial or utility installations to house service drops . . . from B-36's to washing machines Burndy connectors are included in the most exacting engineering specifications. Wherever your job takes you, you'll find Burndy connectors on the job, too. Here are just a few examples of Burndy-engineered connectors:

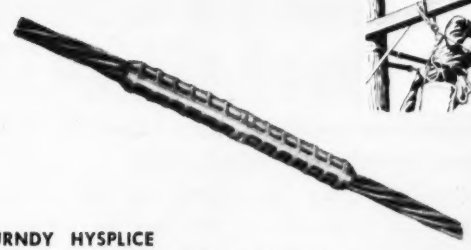




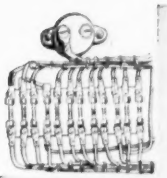
BURNDY BARTAP
Burndy has developed a complete line of heavy-duty connectors—standard and special shapes—of high current capacity. Used in utility substations, industrial power houses, hydro-electric projects, etc.



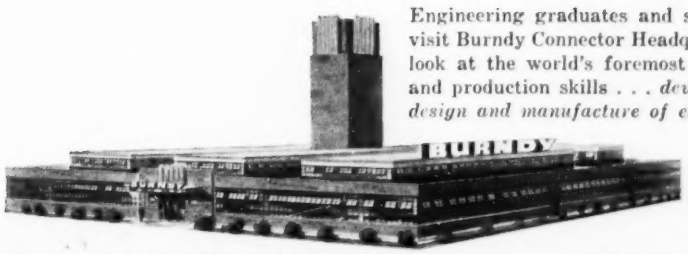
BURNDY SERVIT
Most versatile, efficient and popular split-bolt connector for splices, taps, dead-ends. Used and re-used for sizes #12 Str. to 1000 Mcm. Variations available for aluminum and steel conductors, and for combinations of these and copper.



BURNDY HYSPLICE
These compression splices, installed by Burndy hydraulic tools, are used in power transmission lines, where joints require maximum conductivity, highest mechanical strength.



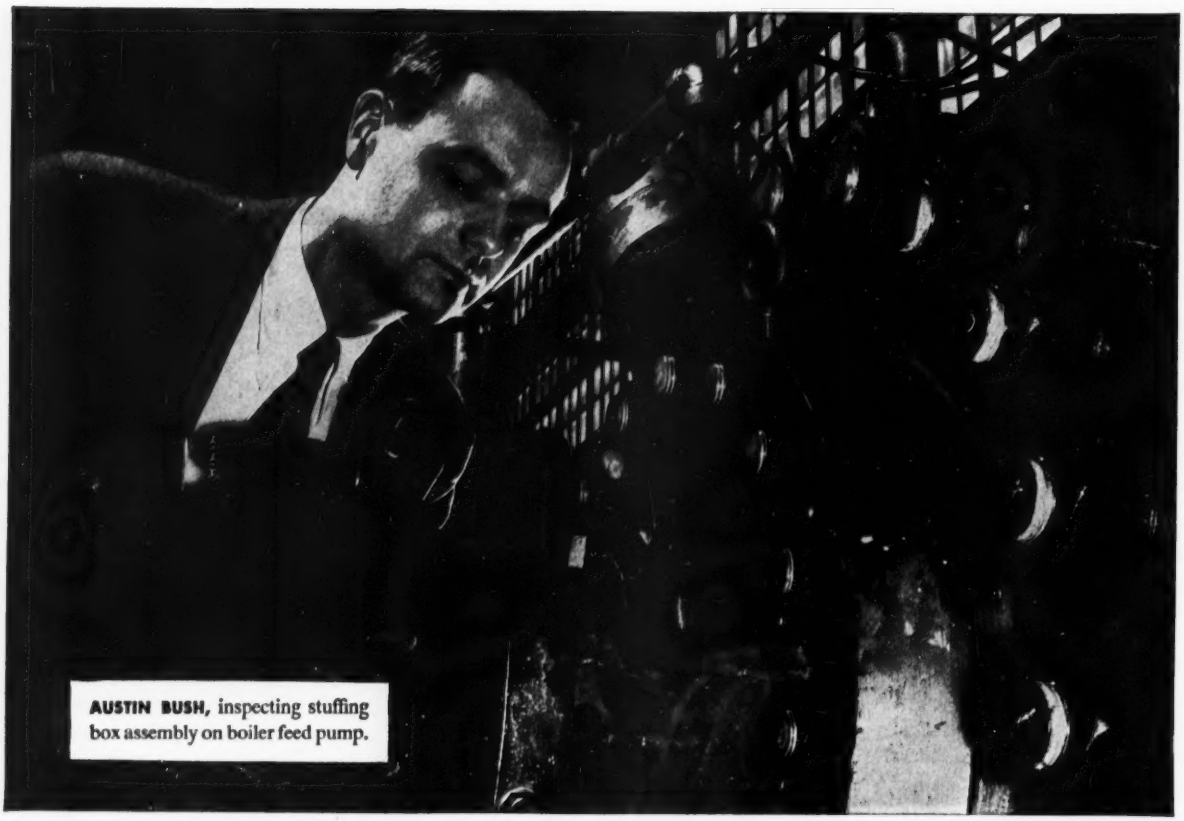
BURNDY HYLUG
Solderless connector of one-piece, pure copper construction—with longitudinal indent method of installation. Adaptable to economical mass-production, used in thousands of plants manufacturing electrical equipment. *A Burndy exclusive.*



Engineering graduates and students are invited to visit Burndy Connector Headquarters for a first-hand look at the world's foremost research, engineering, and production skills . . . *devoted exclusively to the design and manufacture of electrical connectors.*

52-25 **BURNDY ENGINEERING COMPANY INC.,** NORWALK, CONNECT. **BURNDY CANADA LTD.,** TORONTO 8, ONT.

Austin Bush, Rensselaer, '50, Helps Develop New Pump



AUSTIN BUSH, inspecting stuffing box assembly on boiler feed pump.

Reports interesting project engineering assignments at Worthington

"Despite its size as the leading manufacturer in its field," says Austin Bush, "I have found Worthington pays considerable attention to the interests of the individual. The company's excellent training program consists of several months of working with the various types of equipment manufactured, augmented by technical lectures, and talks on the organization of the corporation.

"Following this training, I was given an opportunity to choose the department in which I wanted to work—engineering, sales, or manufacturing. My choice was the engineering department where I have already been assigned to several interesting projects.

"In addition to the training program, the members of our engineering department hold monthly seminars at which engineering topics of general interest are discussed.

"Opportunities for advancement are good, and pleasant associates make Worthington a fine place to work."

When you're thinking of a good job, think *high*—think *Worthington.*

FOR ADDITIONAL INFORMATION, see your College Placement Bureau or write to the Personnel and Training Department, Worthington Corporation, Harrison, New Jersey.

WORTHINGTON

The Sign of Value Around the World

2.54X

An Exciting Past Foretells

A Promising Future

WE don't need a crystal ball to foretell the future of any young engineer who finds his place in the family at Goodyear Aircraft.

For Goodyear's forty-four-year history has been one of teamwork with the aviation industry in forging new frontiers—utilizing the widest scope of engineering talents.

Here is America's only producer of both heavier- and lighter-than-air craft—builder of a wide range of aviation equipment which includes guided missiles and the electronic equipment which controls them.

Here has taken place research, development and production of metals, plastics, devices and structural designs not only for aircraft—but for many far-flung fields as well.

From it came the first use of Duralumin in the construction of aircraft, and the development of many of the processes now used in shaping and forming metal structures.

From it came honeycomb structures with the strength of solids, electrically transparent enclosures for jet radar—and the radar itself—enclosures that must withstand 600-mile-an-hour raindrops.

From it has come complete airships, airplanes, fuselage shells — and countless aircraft components for practically every member of the industry.

All this and more has been made possible by the talents of young engineers who have come to Goodyear Aircraft because they have found it a good place to work — *with future assured and opportunities unlimited.*

This is true because Goodyear is one of America's basic industries—a place that will always be doing business, come defense, war or peace.

Where will you find a broader, surer opportunity?

ENGINEERS WANTED *for research, design and development of:*

AIRPLANES, AIRSHIPS, HELICOPTERS, GUIDED MISSILES, ELECTRONIC COMPUTERS, AIRCRAFT COMPONENTS, RADOMES, WHEELS AND BRAKES, TRANSPARENT ENCLOSURES, REINFORCED PLASTICS, BONDED SANDWICH STRUCTURES, RADAR STRUCTURES and many other challenging opportunities.

Submit a brief resumé of your qualifications and experience, or write us today for an application blank and further information. Address: Dr. K. Arnstein, Vice President of Engineering, Goodyear Aircraft Corporation, Akron 15, Ohio.

GOODYEAR—The Company with COMPLETE Coverage in the Aeronautical Field

Welcome . . .

THE CORNELL ENGINEER joins with the faculty and students of the College of Engineering in welcoming the freshmen of the class of 1958. You are entering one of the most important periods of your life, as you become students of a university which has long been respected for the excellence of its engineering training. It is up to you to make of your education here the rewarding experience it can be.

Like those who have gone before, you new students have differing goals and interests. Some of you may have definite plans; others of you will develop your interests and modify your ideas as you progress in your college career. You who find yourselves in engineering because "Dad thought it was a good idea" or because "it looked as good as anything else" will soon discover where your ability and interest lie. There are those among you who will eventually find more satisfaction in liberal arts, in science, in another branch of engineering, or in architecture. We hope you will not make your decisions hastily before you have made a fair evaluation of your engineering education and a sincere attempt in your studies.

Cornell is distinguished from many other engineering schools in that it offers students a wide range of curricular and extra-curricular activities. This situation was for some of you a deciding factor in your choice of schools. It is a distinct advantage in your preparation for useful community life, but it can be a disadvantage if you do not plan your college career wisely.

You will have to be selective in your choice of activities if you are to gain satisfaction from these activities and if you are to keep the balance you need between work and play. It is very easy in an institution such as this to slight one's studies and to overlook the educational values of lectures and concerts for the pleasurable activities of the moment. There are few who reach their last year in college without wishing they had found more time for some courses and had not passed others by, or had taken advantage of some activities less easily enjoyed outside a university.

Cornell's engineering program is designed to meet the demands of the industrial world of today. It is a flexible curriculum which does more than to instruct the student on the use of handbooks and drawing instruments and the manipulation of formulae. It provides a challenge for the interested individual, and it merits the respect of students and educators within and without the engineering field.

We do not say that there will not be times when you will feel a course to be of little value, and that you will not encounter some griping among engineering students and ridicule among those in other fields. The first few years in any field of study must necessarily include courses in fundamentals that can often seem tedious and undirected. However, more freedom has been given Cornell students in their choice of electives than is given students of many other schools; and the five-year program provides more time than the usual four-year curriculum for courses in the humanities.

Some of you may wish to take extra hours or to audit courses. From your contacts with older students and with faculty members in activities and in the professional engineering societies, you will discover the many opportunities available on the Cornell campus for broadening your education.

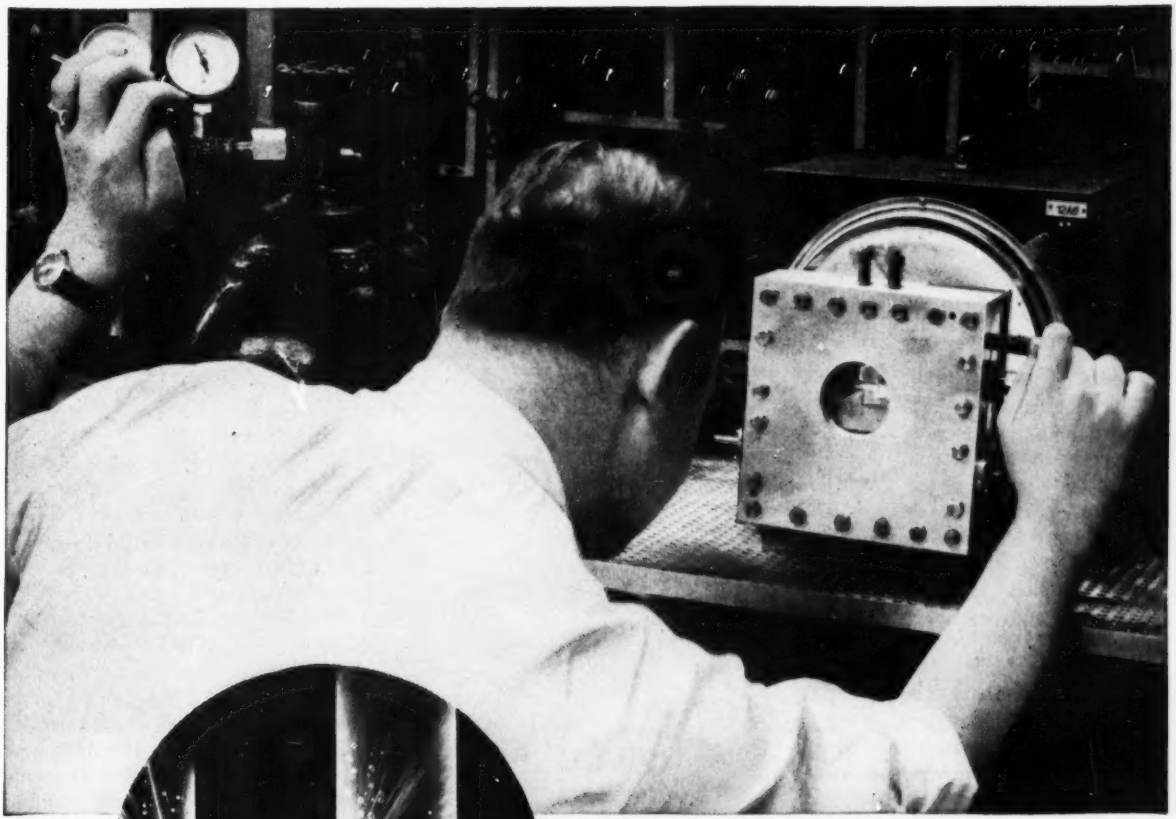
The engineer, of course, can hardly hope to gain as much general information from his formal studies as the arts student; yet many outside the fields of science and engineering look with awed respect upon those gifted with analytical minds—and not entirely without reason. The understanding of the basic laws of nature and the ability to analyze the workings of our physical environment are almost impossible for the layman to possess, in the sense that those in technical fields can possess an appreciation, through informal study, for the social sciences and the arts.

The properly educated engineer should develop the sort of inquiring mind which will make more useful the tools of his profession by the acquisition of knowledge in other fields. Dexter S. Kimball, for many years dean of the College of Engineering, remarks in his autobiography, "I have known not a few technically trained men who have made a great effort to broaden their educational background, and when you do find such a man, he is a superior sort of fellow whose judgment is second to none."

The road will not be easy. You will find that technical work, to a greater degree than non-technical, requires an alert mind and stimulates keen competition. Grades may at first seem important to you; they are in some measure an indication of your ability and accomplishments. However, more important than your scholastic rank is your satisfaction with what you learn and your ability to apply your knowledge and to continue your education after college.

The five years will pass quickly. It will not be long before you will be joining the ranks of other Cornellians who have found satisfaction in their work and pleasure in community life. We wish you luck in the career that lies before you!

—J.B.



This Sperry engineer is applying the fundamentals of hydraulics to determine oil flow characteristics at high pressure. Here he introduces nitrogen to the hydraulic fluid in a complex valve to make flow patterns visible for study.

There's Job Diversity at Sperry

FOR THE GRADUATE ENGINEER!

Right now there are openings for...

- Aeronautical engineers
- Electrical engineers
- Electronic engineers
- Mechanical engineers
- Physicists
- Technical writers
- Field engineers for applied engineering

In each field you work with leaders on interesting projects vital to the nation's well-being—long-range projects with a future—projects that call for originality and fresh thinking.

You share in Sperry's prestige

You'll be proud to say you're a Sperry Engineer. Because, as a member of the engineering staff, you'll share in a forty-year reputation for leadership. Today Sperry is the acknowledged leader in the field of automatic controls for navigation. From Sperry's work in gyroscopics and electronics have come the Gyropilot* flight controller, Zero Reader* flight director, Microline* test equipment, radar, servomechanisms, computing mechanisms, and communications equipment.

Attractive locations

Long Island—A pleasant suburban atmosphere convenient to New York. Modern plant. Well-equipped laboratories. Excellent working facilities.

In the Field—There are excellent applied engineering opportunities in various sections of the United States and abroad.

Good working conditions

The way is clear for steady advancement. You are encouraged to continue your education while you earn. And liberal employee benefits are provided for all.

Check your placement office for dates when Sperry representatives will visit your school ...or write Sperry employment section 1 A S.

*T. M. REG. U. S. PAT. OFF.

SPERRY GYROSCOPE COMPANY
DIVISION OF THE SPERRY CORPORATION

GREAT NECK, NEW YORK • CLEVELAND • NEW ORLEANS • BROOKLYN • LOS ANGELES • SAN FRANCISCO • SEATTLE
IN CANADA • SPERRY GYROSCOPE COMPANY OF CANADA, LIMITED, MONTREAL, QUEBEC

FROM THE DEAN

Welcome . . .

It is a pleasure to welcome you to Cornell as members of the Freshman Class in Engineering.

I am sure you have come to realize that you are entering now the most important period of your preparation for a lifetime career. The direction and shape of your future very likely will be determined to a considerable extent in your next five years at Cornell—five years which constitute the most productive investment you can make for a successful career. I cannot urge you too strongly to keep in mind that in this time you must establish a foundation upon which you can build a professional life for thirty, forty, or fifty years.

You are entering upon a rather unique program in engineering education— a full program integrating liberal subjects with your engineering training. This program has been adopted by Cornell after a serious study of the requirements for a successful engineering career in today's world. These requirements demand that the young engineer have sound basic technical training, and that he have as well an understanding of the functioning of human agencies in the world about him. It is our purpose, therefore, that you will construct here the foundation for the full breadth of your professional future.

To what pattern, then, shall we plan your engineering training? The answer to that lies in the recognition that today the engineer is no longer a highly individualistic, specialized technician. He is a professional man in every sense of the word, skilled both in the use of science for the solution of a broad range of technological problems and in the application of his methods of rational analysis to economic, social, and business affairs. So it is that, whatever your immediate field of interest may be now—construction, electronics, machine design, chemical processing, or any of a variety of others—you will probably find that your career will call you into many activities you cannot now anticipate.

S. C. Hollister

You will find also that your scholastic training must have such firm roots that whatever advances in engineering may come about—and certainly such advances are occurring with increasing acceleration—you will have the background that will enable you to advance your own abilities with the growth of the profession, and in fact provide the leadership for that growth.

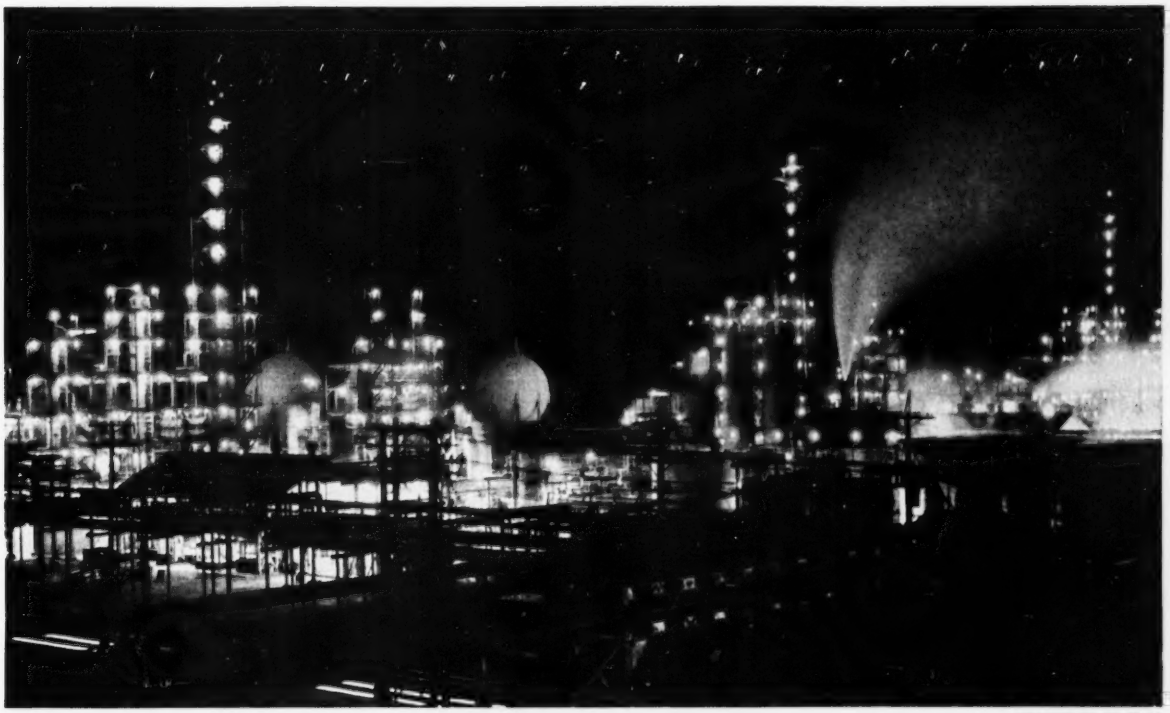
And finally, as your career brings you into contact with people and problems in the whole range of human activity, we want you to have been stimulated at Cornell to a continuing intellectual growth that will gain for you distinction as a citizen and a person as well as an engineer.

The engineering curricula at Cornell provide a superior educational preparation, second to none. They are designed to train for professional leadership, and as such they are demanding of our best mutual efforts. I can assure you that we are determined to work with you in every way possible to bring about the most effective kind of educational experience.

It would be unrealistic, however, to expect that the path will be smooth and trouble-free for all. It is likely to be the most challenging you have ever attempted, but by the same token, also the most rewarding. For some the adjustment of these first few weeks may be difficult and perhaps even momentarily discouraging, but I want you to know that we stand squarely behind you, asking in return your own sincerity of purpose. You have been chosen for the engineering program at Cornell on the basis of a highly selective admissions procedure. We think you can become a Cornell Engineer, and our every effort is directed toward having you take your place in this distinguished family.

In urging you to your maximum effort I do not intend to sound an unnecessarily stern note. This is a joyous occasion and the beginning of one of the most happy and fruitful periods in your life. The opportunities for your personal development will be almost limitless. Cornell is a spiritual as well as an intellectual experience, and I hope that you will take full measure of all that is here for you.

You are part of the almost minute percentage of young people your age who are in this most fortunate situation. I congratulate you on the opportunity that is before you. The College will watch your progress with warm interest and will assist you in every way to achieve your goals.



STANDARD OIL CO. (N. J.)

OIL REFINING 'ROUND THE CLOCK is only one of many chemical process industries which consume vast quantities of catalyst carriers or supports to promote efficient chemical reaction. CARBORUNDUM® makes catalyst supports of the "man-made minerals" available in 17 different compositions and three different degrees of porosity, the better to meet the varied needs of a wide range of processes. The right combination of composition and porosity assures maximum dispersion of the catalyst, while high chemical stability and great mechanical strength assure long support life. In both fixed-bed and fluid-bed applications, CARBORUNDUM catalyst supports are widely used throughout the industry.

Produced by the Refractories Division

Where's the limit to what you can do with CARBORUNDUM's *"man-made minerals"*?

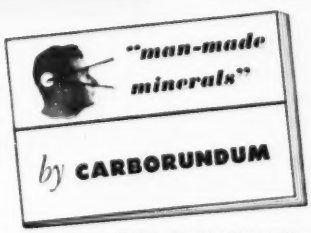
THE BEAUTY OF A BRIAR PIPE is no accident. Bowls, tops, shanks—even the plastic or hard rubber mouthpieces—are roughed and finished with abrasive paper. Leading pipe manufacturers buy CARBORUNDUM silicon carbide abrasive paper in rolls from which they cut special shapes and sizes for use on flat or "French" wheels.

Made by the Coated Products Division

PURER STEEL is the constant goal of leading steel company metallurgists, who are striving to increase the quality of steel without adding substantially to cost. They are powerfully aided by FERROCARBO,® a special formulation of one of CARBORUNDUM's "man-made minerals," which does a remarkable job of purifying molten steel by carrying off metallic oxide impurities into the slag.

Manufactured by the Bonded Products and Grain Division

SEND FOR THIS 28-PAGE BOOK describing how imaginative thinking—yours and ours—can put "man-made minerals" to work for you. Write for it on your business letterhead. No obligation, of course.



Write to CARBORUNDUM

REGISTERED TRADE MARK

for help on your problems that "*man-made minerals*" may solve

THE CARBORUNDUM COMPANY, NIAGARA FALLS, N. Y.

Manufacturers of Refractories • Heating Elements • Resistors • Metal Additives • Grinding Wheels • Coated Abrasives • Sharpening Stones • Abrasive Grains

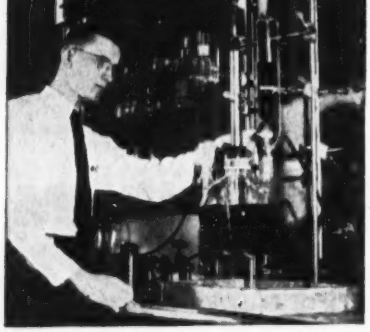
THE DU PONT DIGEST

Research

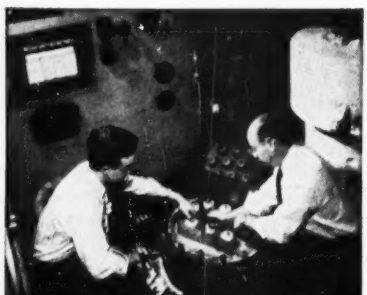
provides broad opportunities for chemists, physicists and engineers cooperating on many problems.

For one thing, much Du Pont research is fundamental, aimed at advancing scientific knowledge regardless of specific commercial objectives. However, such research often suggests new products . . . each with its own challenging technical problems which must be solved before commercial production can begin. Solving these problems offers another great field of work for teams of engineers and scientists.

"Teflon" tetrafluoroethylene resin is an example of this well integrated teamwork.



Howard E. Holmquist, *Ph.D. in Org. Chem., Univ. of Minn. '51, is shown at work on a problem in synthetic organic chemistry.*

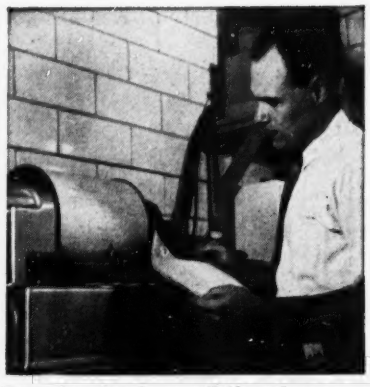


Doing chemical *engineering research on a plate in a distillation tower are: C. M. Gamel, Jr., S.M.Ch.E., M.I.T. '48; and J. B. Jones, M.S.Ch.E., Univ. of Mich. '46.*

During research on refrigerants, the polymer was discovered and work was begun to make it useful. The new plastic had a remarkable combination of properties; temperature resistance beyond the range of any previous plastic, excellent electrical characteristics, and the highest degree of chemical inertness of any commercial plastic.

In fact, "Teflon" was almost too unusual. Although it melts, it is too viscous to flow like other plastics. It does not dissolve—even in aqua regia. There was no method for molding it or for making it into thin coatings.

The problem of molding was solved with the help of techniques used in powder metallurgy. "Teflon" is now molded by cold pressing, followed by sintering or "fusing" at about 360°C.



Research workers *have available modern apparatus, such as the infrared spectrometer being used here by Vaughan C. Chambers, Ph.D. Org. Chem., M.I.T. '50.*

For coatings, previous research suggested dispersions—minute particles suspended in a liquid. After much study, a team of technical men learned how to suspend particles of "Teflon" about 1/125,000 of an inch in diameter. Then a commercial scale process was devised. This development made possible thin coatings of "Teflon" and also a process for extruding the material.

Meanwhile, another group discovered how to successfully formulate the new plastic into "Teflon" tetrafluoroethylene resin finishes and wire enamels.

The development of "Teflon" illustrates the close teamwork that is the basis of research at Du Pont. But this teamwork doesn't end with research. Bringing the product to commercial reality requires development and design work by chemists and both chemical and mechanical engineers. Next month's Digest will feature information on the opportunities Du Pont offers men interested in this phase of making "better things for better living . . . through chemistry."

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OCTOBER, 1953 VOLUME 19 NUMBER 1

COVER—Goldwin Smith Hall with statue of Ezra Cornell in foreground.

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Glass Fibers

by THOMAS REED, ME '56

Thousands of years ago the Phoenicians stretched hot balls of glass into strings for decorations. Today the same thing is being done in glass fiber plants throughout the country, but the advances in technique and the resultant accuracy now obtained have opened a vast new field of application that would have been inconceivable in the days of the Phoenicians. Almost all the progress made in this field has taken place in the twentieth century.

In the late nineteen twenties the Germans first produced glass fibers on a commercial scale. Used for decorative purposes only, these fibers were non-uniform in almost every respect. During the depression in this country one of the major glass companies began to search for markets for other types of glass products. This initial work led to development of throw-away air filters and was soon followed by the development of a relatively coarse-fibered building insulation. Later, platinum crucibles and resistance heating were developed which led to many varieties of thermal and acoustical products. Glass textiles were likewise an outgrowth of the same development. During World War II the glass fiber industry received its greatest boost with the need for a lightweight, fireproof insulation. This need was accentuated by the shortage of asbestos. As a result, plants were set up to provide blown "glass wool." The famous Victory and Liberty Ships were insulated with glass fiber wool blankets. The resultant growth of the industry during the war was enormous. Glass fiber sales in 1939 amounted to $15,000,000 while in 1944 they had jumped to $40,000,000.

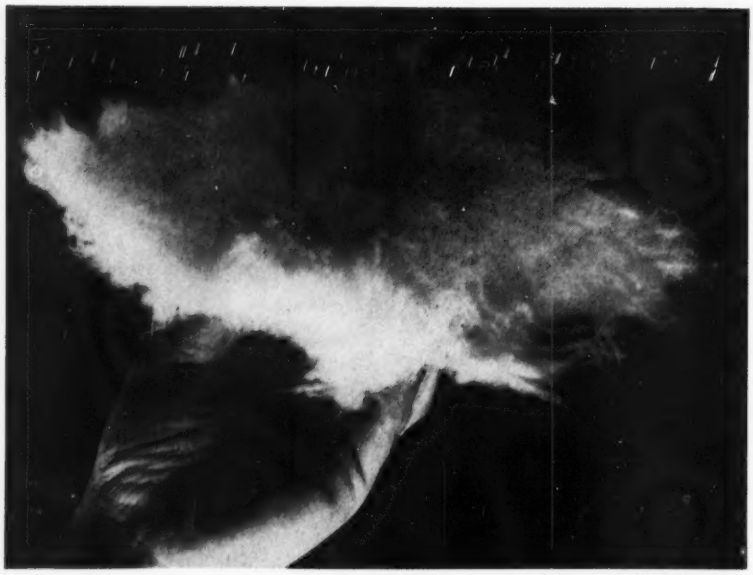
Filaments, so infinitesimally fine as to be almost invisible, are drawn from molten glass.

—Glass Fibers, Inc.

Method of Production

The method of producing a fiber of glass is based on elementary principles. Although the material is very brittle when it has a large cross-sectional area, by decreasing this area to infinitesimal dimensions the glass will become increasingly flexible. This may be made clear by thinking of a large block of glass. Any effort to bend this would only result in fracture. But think of the thin glass tubing found in chemistry laboratories. It is recalled that a length of this at room temperature will bend a surprising amount. Now consider a fiber with one tenth of one percent of the cross-sectional area of the human hair. It seems logical, doesn't it, that this strand would be quite flexible? Such turns out to be the case. The problem, then, consists of making glass of the desired composition, heating it to a temperature that is uniform, and then drawing it to the desired fiber diameter. Under the last heading a choice must be made as to whether a textile-type or wool-type product is desired.

In the preparation of the glass, consideration must be given to the final uses of the product. The more durable, alkali-free glass used for electrical insulation and fine-fibered wools of all types is composed of about 55% sand, 16% alumina, 20% lime, and 10% boric oxides. Since no alkali is present in the glass, high temperatures are required for its melting and, as a result, fibers are drawn at about 2,300 degrees Fahrenheit. If, on the other hand, the end product is to be a coarse fiber product like an air filter mat, a soft, less durable glass consisting of approximately 70% sand and the balance in lime, alumina, boric and alkali oxides may be used. This glass "batch" is first heated in large glass furnaces and then extruded in the form of marbles about 3/4 of an inch in diameter. This shape is desirable for ease of fabrication and simplification of feeding in the drawing process which follows. If fibers are now to be made, the marbles are fed into a crucible where they are once again heated, small filaments of molten glass exuding from the 204 holes in the bottom of the crucible. The glass is pulled out rapidly (about 10,000 feet per minute or roughly 120 miles per hour) and attenuated to a diameter in the range of tenths of thousandths of an inch. It is in this heating and drawing stage that the two major processes used at present—those patented by Owens-Corning and Glass Fibers, Inc.—differ in one important respect. Owens-Corning heats a rectangular crucible to the desired temperature by resistance heating with two electrodes at the ends of the crucible. This may give rise to a temperature gradient resulting in fibers that may not be uniform in diameter. In the electronic extrusion process a round crucible is heated by induction methods using a copper, water-cooled work coil that never comes into physical contact with the crucible itself. Heating is uniform throughout the crucible



—*Glass Fibers, Inc.*

Quartz micro-fibers have diameters as small as .16 microns, withstand temperatures of 3,000 deg. F.

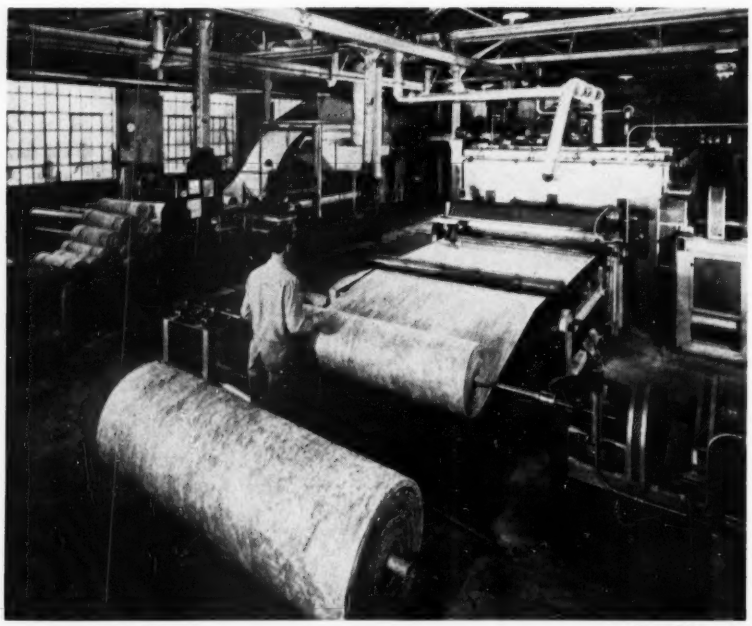
and, as a result, the fibers tend to be more uniform in diameter. In addition to temperature, the speed with which the fibers are pulled determines the fiber diameter. After being pulled from the crucible these fibers are drawn over a lubricating pad and are coated with a binder consisting mostly of starch and water, which gives each strand a protective covering that keeps it from abrading or cutting other fibers next to it. The fibers are gathered on spools and are taken to another department, where they are twisted, plied, and packaged to meet customer specifications.

Superfine Fibers

Suppose, however, that the marbles are to be made into "superfine," light-weight glass wool. In this case they are heated as before by either of the two processes, but are now drawn slowly (about 60 feet per minute) from the bottom of the crucible. Since there are several hundred holes in the bottom of each crucible, this is quite an amount of glass. These thick fibers are then drawn by rollers into a gas jet where the glass is melted and flame-blown almost instantly into fine fibers having infinitesimal diameter. When drawn slowly from the crucible the fiber diameter is in the range of hundredths of an inch; after flame-blowing it is hundredths of thousandths of an inch. While flying through the air, the glass is uniformly coated with resinous compounds which act as a binder or glue to hold the wool mass together. The fibers are then caught on a screen, heated to bake and cure the resinous binder, and rolled up. The mat thus formed is usually up to two inches thick. It is very light and fluffy and due to the binder will be resilient and will hold its shape forever.

Uses

Glass fiber products have a myriad of uses in the present-day world. The woven fibers, for instance, are used in electrical work. When a motor is wound with glass fiber insulation, the temperature that the insulation will stand is no longer the determining factor in deciding the motor rating. Also it is possible to cut down the size of the windings considerably, since glass insulation on the wires occupies much less room than cotton does. Glass can also replace asbestos, since it is more readily available and since asbestos contains traces of iron, which, naturally, is not desirable in an insulator. These glass products will not rot or mildew. When used for upholstery or curtains, the fact that glass is fireproof assumes importance. It resists chemical action and is a great deal stronger than other fabrics. Glass yarn is also used to make plastic laminates. For this, glass fibers are sprayed with plastic; and when several layers of these are laminated together, a very light substance is obtained that is stronger than steel in shock loading. These plastic laminates are used for



—*Glass Fibers, Inc.*

Roll-up end of machinery for light-weight glass wool.

radomes in modern aircraft, since the electromagnetic waves will penetrate the substance with ease, yet this very strong material will protect the delicate radar antenna from damage. The light bulletproof vests used in Korea to save so many lives were made of this laminated glass and plastic.

Superfine wool also leads its field in many respects. It is the most efficient sound and thermal insulator known. As a result it sees great use in the aircraft industry. Where every pound counts, superfine keeps the inside of an airplane at a tolerable temperature and dampens engine sounds satisfactorily with the least expenditure of weight. Because of its excellent damping capacity, superfine is placed under the hood, in the cowling, and in the roof of almost every new car made today to quiet engine and road noise. Because this material can be pushed into almost any shape, it can be used to insulate irregular spaces that pre-formed insulation could never fill. Superfine, when sprayed with silicones, is completely water repellant and as a result is used by the Navy for filling its life preservers. In this line it replaces kapok, a naturally occurring silky fiber that begins to rot as soon as it is picked; ageless glass will not rot when the life preservers are stockpiled for great lengths of time. Superfine is also used on a limited scale as an upholstery filling, since it is soft, resilient, and holds its shape indefinitely.

This is a very brief glimpse of the glass fiber industry as it is today. But what lies ahead? Two startling new products are under experimental production now. One is quartz micro-fibers consisting of 99% silica. This product is able to withstand temperatures up to 3,000 degrees Fahrenheit without even softening. Already made in small quantities, this material is used to wrap the extremely hot tailpipes and afterburners of jet engines. Also in the experimental stage is glass micro-fiber pulp to be used in the manufacture of paper. One-third the weight of wood, glass is naturally white and is available in unlimited supply, as opposed to wood. The possibilities for such a product are impressive, particularly in the electrical insulation and filtering fields.

Glass has ceased to be solely a container for foods, drugs, beverages, or a construction commodity for use in windows. It can now replace cotton, steel, kapok, rubber, asbestos, and hundreds of other materials. In the form of glass fiber it has become a basic industrial substance.

This Month's Brain Teasers

For your enjoyment and mental stimulation, THE CORNELL ENGINEER has expanded its monthly "Brain Teaser." Instead of just one brain teaser, we now have three. Furthermore, we are offering a cash award of $3 to the person who submits the first set of correct answers to all the problems. A complete solution is required for each problem, and in case of a tie, duplicate awards will be given. The answers to the puzzles in this issue will be found in next month's ENGINEER.

I. $\log_{10}648=2.81157$
$\log_{10}864=2.93651$

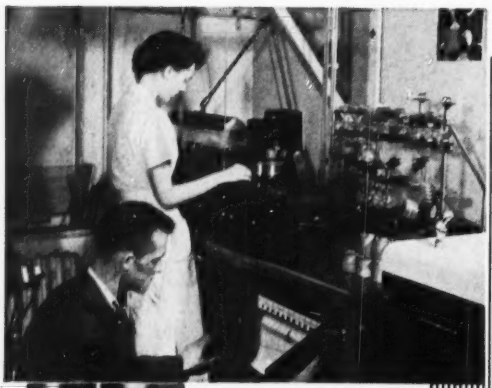
Using just the information given above, plus the basic rules governing logarithms, find $\log_{10}15$ to five decimal places.

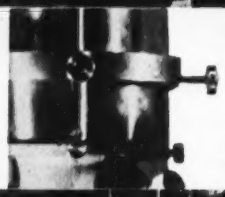
II. Evaluate:

$$\sqrt{2}^{\sqrt{2}^{\sqrt{2}^{\sqrt{2}\cdots}}}$$

Each square root of two is the exponent of the one preceding it, and there are an infinite number of such exponents.

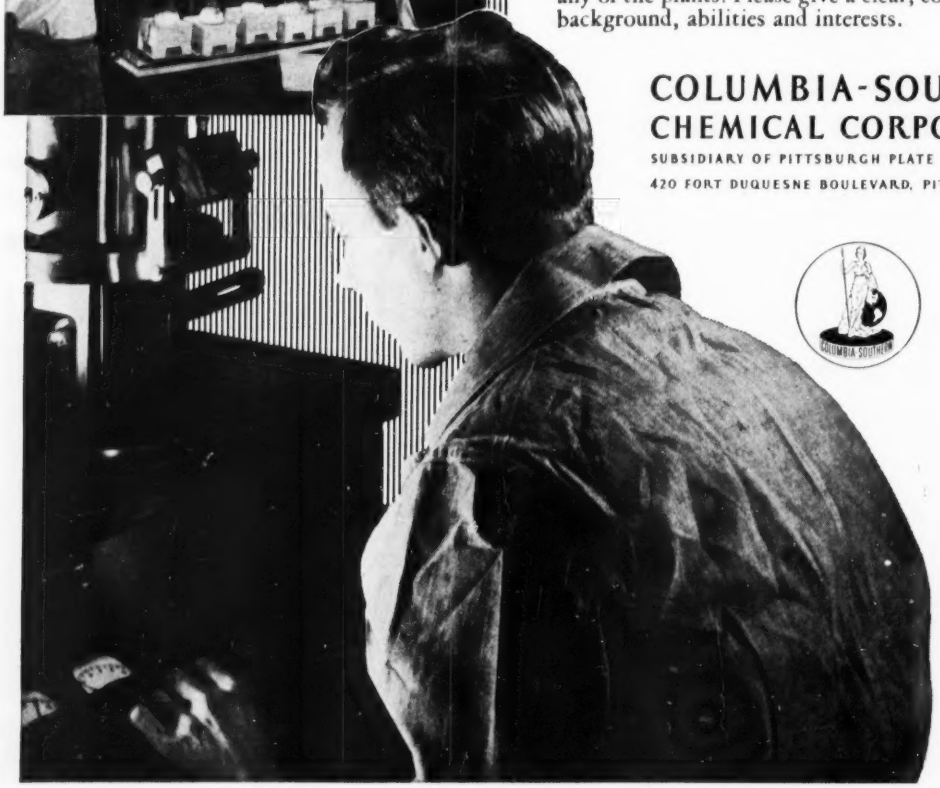
III. A monkey and his uncle are suspended at equal distances from the floor at opposite ends of a rope which passes through a pulley. The rope weighs four ounces per foot. The weight of the monkey in pounds equals the age of the monkey's uncle in years. The age of the monkey's uncle plus the age of the monkey equals four years. The monkey's uncle is twice as old as the monkey was when the monkey's uncle was half as old as the monkey will be when the monkey is three times as old as the uncle was when the uncle was three times as old as the monkey was. The weight of the rope plus the weight of the monkey's uncle is half again as much as the difference between the weight of the monkey and the weight of the monkey's uncle plus the weight of the monkey. How long is the rope, and how old is the monkey?





Making an analysis with the infra-red Spectrophotometer.

Testing action of Perchlorethylene on various metals.



Focusing the Electron Microscope on a chemical sample to be photographed.

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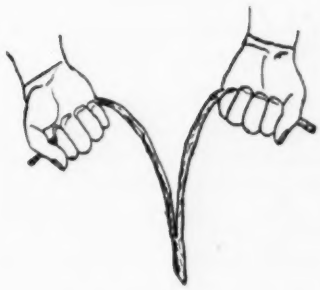
THE DIVINING ROD



by EDWIN LEVENTHAL, EP '56

"He arrived one very hot day towards the end of July. . . .Proceeding to the nearest hedge, he cut a small forked branch, which chanced to be of birch. . .He cut down the fork to a rough V, about a foot and a half long, and holding one extremity in each hand, at once set off in a very rapid walk. . . . (He) never slackened pace for a moment, though very soon the fork began rapidly to turn round and round. . . .Near the top of a slight elevation. . .he stopped abruptly, saying, 'I have been following up a stream—the spring is here—it is about seventy to a hundred feet below the surface, and the water rises at the rate of 120 gallons per hour.' His diagnosis proved correct in every particular."[1]

This is an eye-witness account of a "diviner" at work. Claiming the "divine" power to perceive the presence of underground water and minerals and, in some cases, to reveal information about the past, present, and future, the diviner has for ages defied the concepts of science. Many attempts have been made to place this curious art on a scientific level, but no one has yet produced a theory which is satisfactory to all. Authorities and researchers agree on many points, but an all-encompassing theory is lacking.

There are many people today who refuse even to concede that dowsing, the art of seeking water by means of a divining rod, is any more than out-right guessing, which the dowser sometimes supplements with keen geological knowledge. Many people, however, are satisfied that the dowsers' record of accuracy is indicative of the fact that physical laws are involved. The case against dowsing, as reviewed by the public, is enhanced by some dowsers who claim that extraordinary powers are possessed by the divining rod if it is used by any of the select group for whom the rod has meaning. They claim powers which are beyond physical interpretation and often delay progress. One dowser claimed the ability to locate water in an area by using his divining rod as he traced a map of that area. Others say that they can forecast future events. Clearly instances such as these obscure any significance that dowsing as a physical principle might have. Many researchers have been snared in their attempts to analyze the situation because they have tried to postulate theories which would ally the movement of the rod over water and minerals with the movement in cases where a physical interpretation is out of the question. This is not to scoff at those claims which are based on non-physical reactions, but merely to suggest that a division of study is necessary if we are to explain either type of phenomenon.

Origin

The origin of the term "divining rod" lies probably in biblical times. Moses touched a rock with his staff, and water sprang forth; Aaron's rod bloomed with vegetation, indicating that he was to be a leader of his people. Instances such as these which occurred among religious leaders no doubt suggested the divinity which is associated with the rod. However, the term has no significance other than its historical origin. The "select group" has been increased to a large number, as more and more people, out of curiosity, have attempted dowsing and found that they possess some faculty for performing water-seeking feats.

Instrumental in the destruction of the divining rod's divinity was the discovery that the movement of the rod is due entirely to unconscious and involuntary muscular reactions on the part of the dowser. For some time it was thought that the movement of the divining rod was caused by an affinity for water which the dry tree branch, the most common type of divining rod, possessed. When little was known of dowsing it seemed elementary to suppose that in seeking water the hazel or birch branch would dip toward the ground if water lay below, just as the roots of a tree grow towards the closest source of water. Experiments performed by dowsers who are extraordinarily sensitive

1. A. Goodrich-Freer, *Essays in Psychical Research*

have shown that the movement of the rod is merely an amplification of muscular reflexes. These hypersensitive dowsers were able to feel the physical reaction without the aid of any implements. Their results were confirmed by ordinary dowsing methods.

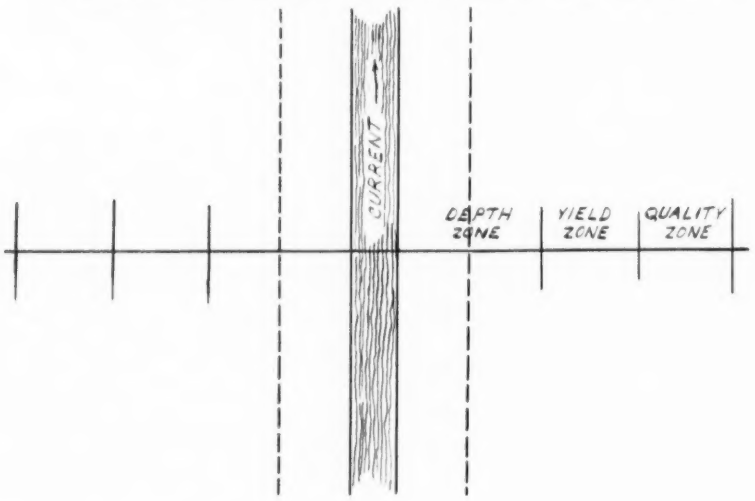
In the eyes of many people dowsing is an art which anyone can acquire to some degree, but which, like any other talent, is more easily performed by certain people. In many cases heredity and environment are major factors, but they are not always significant. It is certainly true that dowsers become more accurate with added experience. Most dowsers offer no explanation for their ability, but state that after a while "you just know that you're right."

Technique

The dowsing technique varies quite a bit with individuals, and many implements and empirical rules have been added to this pseudo-science which began with nothing more than a tree branch and an assertion as to whether water would be found or not. Of these probably the most significant addition is pendulum dowsing. Based on the principle that the dowsing implements serve only to make otherwise imperceptible motion quite noticeable, the substitution of the pendulum for the forked or V twig was an attempt to gain sensitivity by the use of a weight on a string. The advantage of this is immediately obvious, and the pendulum has found great favor among dowsers—so much so, that pendulum dowsing is as frequently employed as ordinary or divining rod techniques.

The pendulum will indicate a reaction by rotating in the dowser's hand, the amplitude of the described circle being used by many practicers as a measure of the capacity of the source. One dowser who has had much success with the pendulum has formulated a set of empirical rules for locating and specifying completely an underground source. Le Vicomte Henry De-France, a former president of the *Association des Amis de la Radiesthesie*, an international union of dowsers, suggests the following methods for determining the value of an underground stream. Walking over the unknown tract, allowing the pendulum to oscillate freely, one will know he has crossed the edge of a stream when the pendulum deviates from its straight line motion and begins to gyrate. A similar attack from the opposite direction will locate the other boundary of the source. If one steps off from the middle of the now located source and swings the pendulum at right angles to the flow direction, a deviation of the pendulum, opposite to the sense of that which located the stream boundaries, will fix the boundary of what he calls the first zone. Similarly two other zones may be delineated, as shown in Fig. 1. In most cases the depth of the source is equal to the distance between the middle of the current and the edge of the first zone.

Fig. 1. **These zones, delineated by points where the dowsing reaction is felt, are said to bear numerical relationship to the factors for which they are named.**



The simplicity of the zone interpretation breaks down from here on, however, and determination of yield and quality requires more complicated mathematics and geometry. In addition the individual must calibrate a chart using known implements under known conditions, since the dowser and his tools are variable factors in the determination.

Methods such as this are typical of the conditions under which dowsers have worked. One other instance should serve to indicate the difficulties which the researcher faces as he investigates the evidence at hand. One particular dowser, employing a forked twig held with its length across the palms of the hand has been able to identify specific materials by counting the number of revolutions which the twig makes in his hand. Conclusions made by this dowser's wife, who was capable of performing identical feats, offer an explanation based on polarity of the hands which causes the rod to turn in the presence of other materials possessing electrical charges. The number of revolutions is limited by the charge difference and is therefore a criterion for identification of a substance's relative charge and of the substance itself. This woman expresses the opinion that everyone possesses similar polarity in his hands, left-handed people having reverse polarity. A different criterion is obtained by inspecting the relationship between the *rate* of the rod's turning in the presence of various elements. (See Fig. 2)

Scope

Up to this point emphasis has been placed on the use of the so-called divining phenomenon for the finding of water. That it, in fact, has countless other uses is revealed by case histories of prominent dowsers who had many other capabilities in fields outside the geological scope.

Several instances are recorded and authorized where dowsers were responsible for the detection and capture of criminals at large. One notable instance involved the trac-

ing of a criminal over a vast countryside with the dowser having no clue except the criminal's collar, which had been left at the scene of the crime. Placing the collar on the divining rod, the dowser set off, tracking his man by visiting inns and taverns until a divining reaction was experienced, indicating that the quarry had stopped there. After many weeks and hundreds of miles of travel the criminal was captured, at which time he verified the dowser's findings. This use of the divining rod as a "bloodhound" is rather uncommon and is particularly mysterious among a mass of mysterious phenomena.

In the field of medicine the use of the divining rod or pendulum to detect disease has met with success and researchers are at a loss to explain why a human (for we must remember that the rod is merely an indicator for a human experience) is affected by another's disease. The accuracy in distinguishing one disease from another had led curious investigators along an aimless path of inconclusive organic theories. Authorities predict that the solution of these events is the key to a vast store of physical and psychical knowledge, and it is in this field perhaps that dowsing holds the greatest potential.

The seemingly unfounded ability of some people to forecast weather is also said to be a phenomenon related to divining. Probably each reader has known or heard of someone who, like the prototype American farmer, could predict rain by the feeling in his corns, head, or back. Just where the relationship lies is undetermined, but the similarities are too great to be ignored.

The divining rod has been able to distinguish between sexes, and there has been talk of its being used to determine the sex of a child in the prenatal period. The scope of the dowser thus extends well beyond the boundaries of water seeking and there seems to be no limit at present to the fields in which dowsing may be used. Authorities are hopeful that many other mystic phenomena, heretofore neglected or attributed to supernatural causes, will be explained by a complete and accurate theory or set of theories.

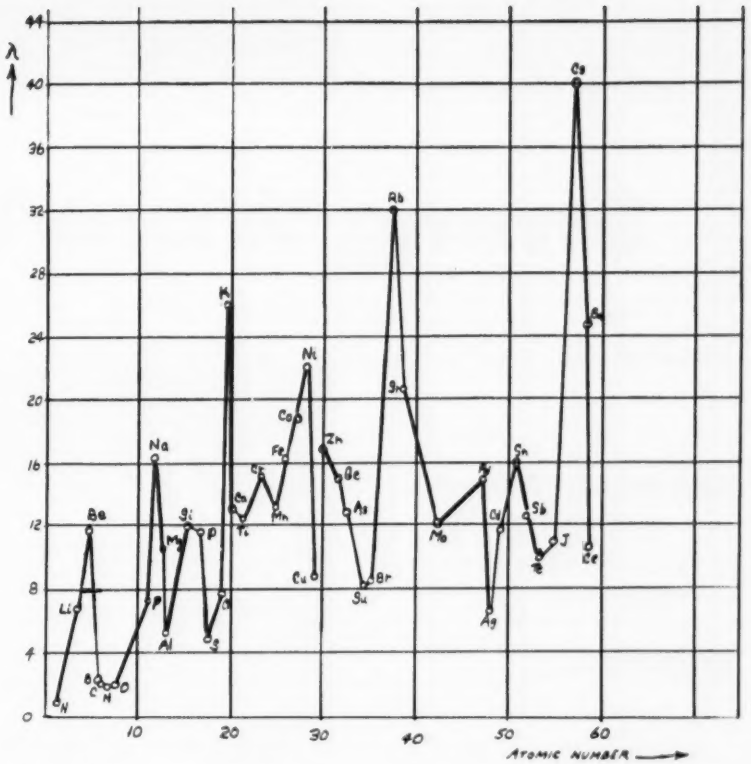


Fig. 2. Relative rate of turning of a divining rod in the presence of some e'ements.

Present Theory

Of the many theories postulated by present-day scientists a few are exceptional for the large amount of experimentation which lies behind them and for their attempts to explain dowsing in terms of what is already known, rather than to form new concepts and terms. These are considered the most outstanding theories today and have the greatest promise for future work.

One of these is the "electric" theory. This attempts to explain dowsing on the basis of a world-wide electric current which varies due to the material differences of the earth's crust. According to this theory a yet undiscovered human organ is capable of detecting variations in this current which are caused by the relatively large differences in the conducting ability of water, say, and the rock and soil which surrounds it. This organ is present in every human, but the dowser is distinguished from the non-dowser by the degree of sensitivity which this organ possesses. This theory is supported by experiments in which dowsers were unable to perform when insulated from the ground.

Another extensive theory is that which establishes an electromagnetic field for both human beings and inanimate substances. This theory stands the oft-resorted-to the interaction of these fields is the muscular reaction which practically all modern theories concede is the direct cause of the divining rod's motion.

In the midst of modern physcial theory stands the oft-resorted-to psychical theory, which adheres to the supernormality of the divining phenomenon. Hampered by incomplete psychical knowledge and confusing experimental evidence, this theory has made less gain than any of the physical theories; however, the insufficiencies of the latter warrant a consideration of other forces which may at some future time be more clearly revealed.

(Continued on page 36)

Patent Law

by JOEL MAX, ChemE '57

Patent diagrams courtesy of Zoltan H. Polachek, patent attorney

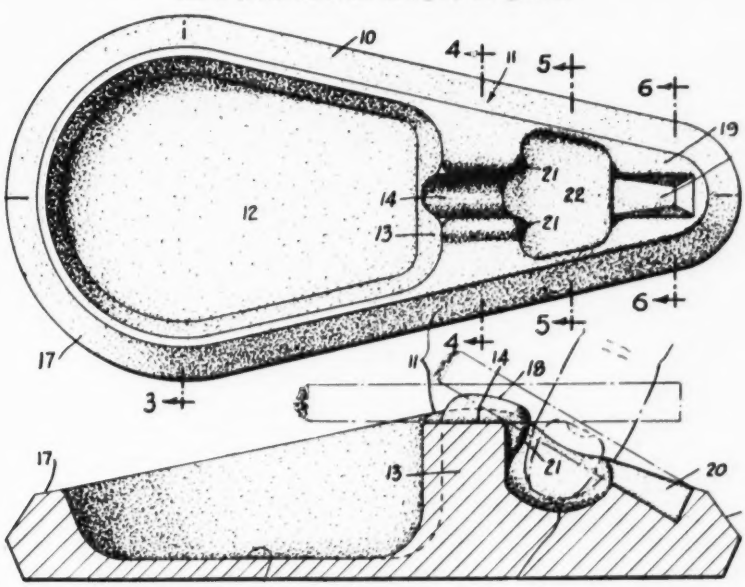
The worth of a great number of the products and processes of industry depends upon the patent monopoly the producer holds on them. Without the temporary monopoly granted by the patent, any organization could freely use the fruits of another's engineering and research. It is important, then, that an engineer, as a person primarily concerned with the products and processes of industry, have an understanding of patent protection.

According to statute, "any person who has invented or discovered" anything that is both new and useful may obtain a patent for it. ("Discovery," as interpreted by the courts, is approximately synonymous with "invention.") The classes of things that fall under the heading of "invention or discovery" are the following:

1. Processes—A process is a manner of treating common articles to get prescribed results.
2. Manufactures — Manufactures are goods produced by the art or industry of man. Machines do not fall into this class.
3. Machines—A machine is interpreted to be a composition of moving and stationary parts adapted to convert power or force to a useful purpose.
4. Compositions of matter—Compositions of matter are mixtures or chemical combinations of elements having new or useful properties.
5. New and useful improvements —Any new and useful improvement or an invention in any of the preceding classifications is patentable. A patent on an improvement does not entitle the patentee to use the original invention, nor does it allow the possessor of the original patent to use the improvement.
6. Plants—Any new variety of plant that may be asexually reproduced by any method except tuberpropagation may be patented.

A manufacture may not be patented if it differs from previous manufactures only in the method by which it is made. Of course, the method itself may be patented. Other things that may not be patented are useless devices, printed matter, machines that will not operate, business methods, unchanged forces of nature, unimportant changes in detail of construction, and ordinary changes in proportion of ingredients.

Safety ash tray patented in 1943. When the ash drops off, upsetting balance, the lit end is prevented from falling by the groove.



Other Factors

There are, of course, other factors affecting the patentability of an invention aside from the properties of the invention itself. The laws concerning prior invention or use of a device are the most obvious. If one is to secure a United States patent on an invention, the invention must not have been known or used in the United States prior to the date of invention. Even if an inventor produces an invention independently and without knowledge of its previous discovery, he will not be granted a patent if the invention has been previously patented, used, or described in the public press.

Even if an invention meets the requirements of law with respect to utility and novelty, a patent may be denied if the inventor "abandons" his invention. Legally, an in-

(*Continued on page* 23)

What's on the horizon for a young engineer?

THAT depends, of course, on where he sets his sights.

The horizon at General Motors is crowded with opportunities for the young engineering school graduate. They are opportunities that he might never discover elsewhere.

From General Motors flow an endless variety of products. Automobiles, trucks, refrigerators, Diesel engines are just a few. In addition, GM defense contracts include shells, bombsights, range finders, tanks and gas turbine engines.

So you can see how a GM engineer has a real chance to follow his natural bent, and work in the field of his choice.

But there's another important advantage in launching your career at General Motors. All work is decentralized among GM's 33 manufacturing divisions, its 116 plants in 57 towns and cities throughout the United States. And though each division operates on its own, each can call upon the vast resources of GM's central research and engineering laboratories.

Thus General Motors, despite its size and scope, gives you the opportunity of working intimately with top engineers, of sharing their knowledge and experience.

Does the opportunity pay off? Many engineering school graduates, now in key jobs at GM, can testify that it does.

Why not check with your College Placement Office and arrange for an interview with our GM College Representative the next time he visits your campus. Or if you prefer, write direct to us.

GM positions now available in these fields

MECHANICAL ENGINEERING
METALLURGICAL ENGINEERING
CHEMICAL ENGINEERING
ELECTRICAL ENGINEERING
INDUSTRIAL ENGINEERING
BUSINESS ADMINISTRATION

GENERAL MOTORS CORPORATION
Personnel Staff, Detroit 2, Michigan

Patent Law

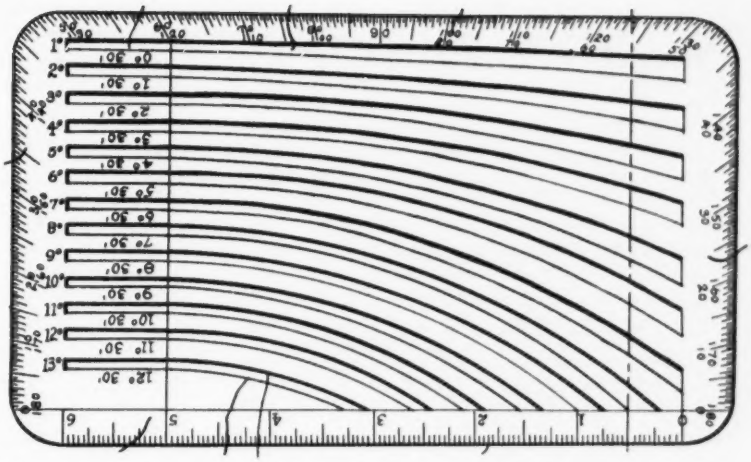
(*Continued from page 21*)

vention is abandoned if the inventor does not reduce it to practice with reasonable diligence or if he chooses to operate it in secrecy. In the first case, if one person invents something and delays unduly in reducing it to practice, a second person, inventing the same thing at a later date and reducing it to practice before the first, may secure the patent. In the second case, it is held that if an inventor chooses to preserve his monopoly of his invention by operating it in secrecy, rather than patenting it, he will be denied patent protection at a later date.

Since the issuance of a patent depends upon the priority of invention, the date of invention should be established beyond reasonable doubt. The date of invention is the date that the idea is first conceived. This date is best established by the inventor's writing a description of the invention, dating it, and having it signed by two witnesses.

According to United States statute:

"Before any inventor or discoverer shall receive a patent for his invention or discovery, he shall make application thereof in writing to the Commissioner of Patents and shall file in the Patent Office a description of the same and of the manner and process of making, constructing, compounding and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art or science to which it appertains, or with which it is most nearly connected, to make, construct, compound and use the same; and in case of a machine he shall explain the principle thereof, and the best mode in which he has contemplated applying the principle so as to distinguish it from other inventions, and he shall particularly point out and distinctly claim the part, improvement, or combination which he claims as his invention or discovery."

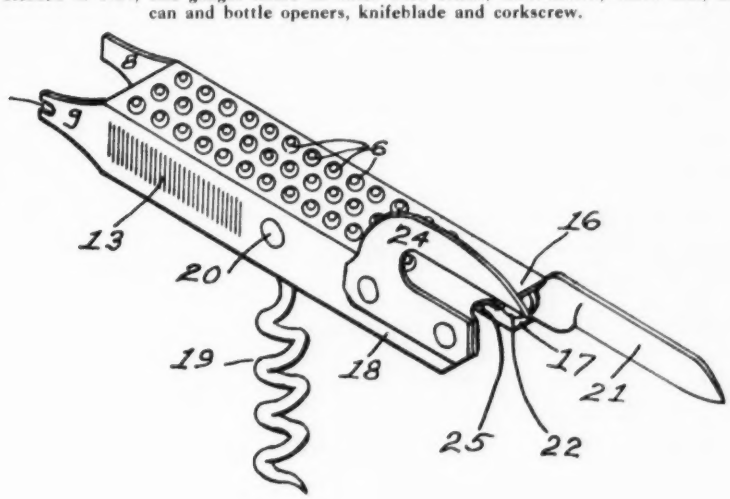


Patented drafting instrument which provides the user with a triple selection of arcs. Original patent has expired.

As stated above, the principal parts of a patent application are the description and the claims. The description names the device, gives its object and composition, gives the method of obtaining it, and gives a detailed description of the device itself. The claims are statements of the unique aspects of the invention. There is no doubt that the claims are the most vital part of the patent, as only the aspects of the invention that are explicitly claimed are protected. A single patent application may contain one claim, or it may contain a large number. The wider the range of application of the invention and the greater its inherent complexity, the greater will tend to be the number of claims. Every claim must be justifiable from the description. The Patent Office may not allow all the claims on the application, but the patent is valid if even one claim is upheld. It is necessary that the patentee disclaim all the rejected claims, or he will void the patent.

When an inventor wants to patent a product and the process for making it, he may cover them both in the claims of one application, or a separate patent may be applied for on each. Sometimes the Patent Office will require that a single application of both product and process be broken up into two separate applications.

Patented in 1934, this gadget offers an inner tube buffer, screwdriver, valve tool, file, can and bottle openers, knifeblade and corkscrew.



Patent Claims

Patent claims on the Haber process for producing ammonia might read as follows:

1. The process for producing ammonia by heating a mixture of nitrogen and hydrogen gases with a catalyst under pressure.
2. The process for producing ammonia by heating a mixture of nitrogen and hydrogen gases to 400 to 600 degrees Centigrade with a platinum, vanadium pent-

oxide, or active iron catalyst, under pressure.

The first claim is a broad claim, which, if allowed, will protect the process completely by covering all the conditions under which it is operated. The second claim protects the optimum mode of operation. If only the second claim is allowed, someone may operate the process in a manner somewhat different from the manner in the second claim, and so avoid infringement. In actual practice, the first broad claim of a patent will be followed by other claims listing the optimum conditions of operation one at a time, as well as complete specifications for the optimum mode of operation, so as to secure the maximum possible protection for the inventor.

The patent application also contains drawings of the invention, a petition of citizenship, and an oath of originality. The application must be accompanied by a thirty dollar fee.

When the application is examined, the inventor may be required to retract or modify some or all of his claims, correct any errors of form, and make up any insufficiency of disclosure. Finally, the patent is issued. On the average, it takes two to three years from the filing of the application to the issuance of the patent.

Patent Rights

According to statute, a United States patent is 'a grant to the Patentee, his heirs and assigns, for the term of seventeen years, of the exclusive right to make, use, and vend the invention throughout the United States and the Territories thereof." What a patent does, is to grant a temporary monopoly. This monopoly extends to the use and sale of a device, as well as its manufacture. If a patentee is not in a position to operate his patent, he may assign the patent to another party. An assignment is a complete transfer of the patent. The patentee may also issue licenses to operate under his patent. In the case of a license, the original patentee still owns the patent, and in the absence of contractual stipulations to the contrary, may issue as many licenses as he desires.

If an unauthorized person violates the patent monopoly, it is up to the patentee to bring suit for infringement against the violator. In an infringement suit, the patentee may recover all profits made by the infringer through the unauthorized use of the invention and obtain an injunction to preclude further infringement. The patentee may also win a judgment for damages.

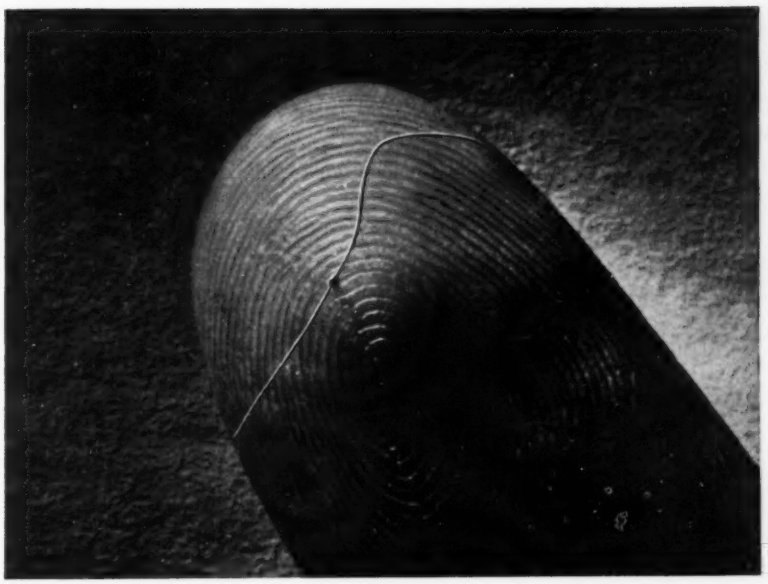
The most important factor in the development of patent laws has been the desire of the government of this country to encourage invention by the grant of patent monopolies and at the same time advance the public good by the widespread use of these inventions. It is the continuing compromise between these two desires that has brought the patent law of this country to its present stage.

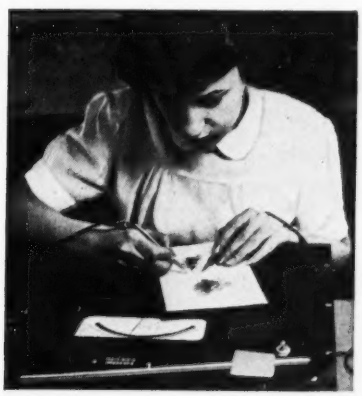
It took 100 years of engineering

See that tiny speck of oxide on a hair-like wire? It's called a thermistor, and it's the first practical *thermally* sensitive resistor. It's so sensitive it will measure temperature variations within one-millionth of a degree. As a circuit element and control device, this small, stable and rugged unit has a place in a variety of electrical circuits.

Although the thermistor is the smallest and, in appearance, one of the simplest devices made by Western Electric—manufacturing unit of the Bell Telephone System—it was more than 100 years in the making.

Back in the 19th Century—some time before Western Electric was founded in 1869—Michael Faraday studied a curious thermally sensitive resistor material similar to that used in 20th Century thermistors. As Faraday and others after him discovered, the trouble with making effective use of this material was that different units made by what seemed to be the same process, showed large variations in their behavior. The problem of how to control the amount of impurities present in the material was finally solved a few years ago by our research team mates at Bell Telephone Laboratories.





At Western Electric's Allentown (Pa.) Plant hundreds of minute thermistor components are electrically tested and sorted every day. The basic component, an oxide, has a large negative temperature coefficient of resistivity.

Once beyond the laboratory stage, Western Electric's engineers tackled the job of *mass-producing* the hard-to-handle oxides. After many trials they got a pilot line in operation—then a full scale production line through which compressed powders of thermistor material could be sintered into a strong, compact and homogenous mass. Today reliable thermistors are being made in many shapes and sizes—small beads, rods, discs, washers—to meet varying circuit and design problems. To make this possible, Western Electric engineers had to find new ways to apply a slurry of oxides on wire; new ways to extrude and mold oxide mixtures.

At every turn, the thermistor has presented fresh challenges to our engineers. Engineering is like that at Western Electric—where technical men of varied skills pool their knowledge in a constant search for new and better ways to do things.

The thermistor takes many forms depending on the resistance and power-handling capacity needed in a particular circuit.

WANT TO KNOW MORE?

Send the coupon below for a copy of the 16-page technical monograph entitled, "Thermistors as Components Open Product Design Horizons."

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COLLEGE RELATIONS DEPARTMENT
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Western Electric

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CORNELL SOCIETY OF ENGINEERS

Thomas W. Hopper

"The objects of this Society are to promote the welfare of the College of Engineering at Cornell University, its graduates and former students and to establish closer relationship between the college and the alumni."

A common assumption that all graduates of the College of Engineering of Cornell University truly appreciate its worth, is not always true. Unfortunately, many alumni have lost intimate contact with the college over the years and have forgotten those particular advantages which make it such an outstanding institution.

Appropriate, therefore, in starting the 1953-54 season of our Society, is a brief reference to certain favorable aspects of a Cornell engineering education. Articles in subsequent issues of this magazine will describe the aims and activities of the Society.

The College of Engineering at Cornell has fine traditions and wide accomplishments in the field of engineering education. From its start in 1862 until the present time, great men and dedicated teachers have been attracted to the staff. Throughout the years, teaching of engineering fundamentals soundly based on science and mathematics has been continued. Entrance requirements and academic standards have been maintained at a high level. A truly rigorous and thorough training is the result.

Expansion and revision of the program at Cornell have been timed to meet the needs of a constantly changing world. The four integral stems of learning are: (1) basic science; (2) applied engineering science; (3) applied technology; (4) general managerial and liberal studies. The College of Engineering now includes the School of Civil Engineering, the Sibley School of Mechanical Engineering, the School of Electrical Engineering, the School of Chemical and Metallurgical Engineering, the Department of Engineering Physics, the Department of Mechanics and Materials, and the Graduate School of Aeronautical Engineering. Graduate instruction in engineering is offered by the Engineering Division of the Graduate School of the University.

An engineering student at Cornell has many advantages in addition to the technical courses that he has chosen. Unobtrusively he absorbs the broad cultural influence of University activities and environment. His everyday living in fraternities or dormitories brings him into social contact with students of liberal arts, agriculture, law, medicine, and other diversified subjects. This creates and nurtures an outlook and understanding that an isolated technical institution could not impart.

The success of an engineer or a business man is attained largely through his ability to solve the various problems inherent in his work. It is fine to possess special knowledge, extensive experience, and a catalog of information on a particular subject; but unless the data can be properly assembled, the basic rules determined, and the fundamentals correctly applied to the problem immediately faced, an effective solution will not be produced efficiently. This technique is rightly named the engineering approach and may well be applied to the solution of problems we all encounter in life.

A keen appreciation of this ability to solve problems, developed under competent guidance and the environment of the University campus, should instill in each one of us a firm confidence when we meet the problems of life as graduates of Cornell Engineering.

THOMAS W. HOPPER

ALUMNI ENGINEERS

Warner D. Orvis, M.E. '07, writes on his trip to Australia and New Zealand: "Most interesting there was flying over the fjords and glaciers of the South Island; most exciting was deep-sea fishing from the Zane Gray Lodge on the North Island. Caught a 339-pound striped marlin and a 584-pound mako shark, largest on record this season." He and Mrs. Orvis were to fly back to their home in Katonah.

Charles B. Watkins, C.E. '15, 5604 14th St. N.W., Washington, D.C., has lately completed his assignment with Alexander Smith, Inc., Yonkers, as construction engineer for the building of a large carpet and rug plant in the "Delta

Charles B. Watkins

Area" of Mississippi. After World War II, Watkins returned with Army units from overseas; he saw service in Italy as Inspector General with troops there. He left active service in the Army in February, 1947, as a colonel, entered the Army Reserves and resumed civilian activities. Until 1941, he was engaged by the Government for many years as engineering specialist studying federal tax matters covering industrial plants and kindred subjects. Three sons are married: Robert, patent research attorney in Columbus, Ohio; Norman, West Point '46, Captain, Fort Lee, Va.; and Joseph, First Lieut., US Air Force Base at New Castle, Del.

Henry A. Heine, M.E. '07, of 7216 14th St. N.W., Washington, D.C., has retired as special assistant to the engineering commissioner in the US Customs Service, after more than thirty-six years' employment.

Westinghouse Electric Corp. advertising of the company's training program pictures **Edwin L. Harder, E.E. '26,** who is a Westinghouse consulting engineer. He "has become nationally known for his analytical and development work in power systems. He is co-developer of the Anacom, an electric analogue computer." Harder lives at 1204 Milton Avenue, Pittsburgh 18, Pa.

Charles H. Capen, Jr., C.E. '17, chief engineer of the North Jersey District Water Supply Commission, Wanaque, N.J., and president of the American Water Works Association, gave a paper at the 1953 conference of the AWWA in Grand Rapids, Mich; he spoke on the design, construction, and functional relationships of the new Wanaque supply line. He lives at 765 Ringwood Avenue, Wanaque, N. J.

Edwin B. McCrohan, Jr., M.E. '27, naval architect, is chief of the division of construction costs, Maritime Administration, Department of Commerce, Washington, D.C. His address is P.O. Box 363, Herndon, Va.

Francis W. Maxstadt, M.E. '16, who has been an associate professor of electrical engineering at California Institute of Technology since 1919, has been appointed registar of the Institute. He and Mrs. Maxstadt reside at 600 Ramona Avenue, Sierra Madre, Cal.

Thomas M. Goodfellow, C.E. '29, has been promoted to superintendent of the Pennsylvania Railroad Pittsburgh Division, with offices in that city. He joined the engineering corps of the railroad

Thomas M. Goodfellow

in 1929 and has been steadily promoted; he was recently superintendent of the Fort Wayne, Ind., Division.

Architect **C. Frederick Wise, B.Arch. '39,** has announced the opening of offices at 253 Ellis Road, Havertown, Pa., and at 101 Charles Drive, Bryn Mawr, Pa.

George O. Young, M.E. '32, has been appointed area maintenance superintendent of yarn at the Chemstrand Corp. integrated nylon manufacturing center now under construction at Pensacola, Fla. He and Mrs. Young and son Duane live at 818 Mulberry Street, Martinsville, Va.

(*Continued on page 30*)

NO. 3 IN A SERIES

The importance of insulations for

THE PURPOSE of electrical insulation is to offer resistance to the flow of electricity and thus to confine electrical potential to the conductor material throughout its length. An ideal insulating material would have infinite insulation resistance and voltage breakdown, a specific inductive capacity of 1 and zero power factor. In addition it would be flexible, physically strong and unaffected by abrading, cutting and impact forces, oxygen, ozone, acids, alkalies and water throughout a temperature range from minus 80 C. to the maximum operating temperature of copper. A conductor insulated with a thin wall of such a material would occupy minimum space and would operate indefinitely even at high voltages in the presence of any or all of the above destructive materials with no energy loss within the insulation. All available insulating materials fail to comply with the above ideal in practically every respect.

Insulations for use on electrical wires and cables which are subject to bending during manufacture, installation or use must have adequate flexibility. Flexible insulations for such uses are of two general classes, depending chiefly on the extent that they absorb or are affected by moisture. In one group are included the homogeneous rubber and rubber-like insulations, made from natural rubber or the synthetic rubbers, GR-S, butyl and silicone and thermoplastic insulations such as polyvinyl chloride compounds and polyethylene. Most of these are highly resistant to moisture. The other group consists of insulations built up of one or more layers of fibrous materials such as asbestos, cotton, varnished cambric, various synthetic fibers and paper. Even though these fibrous materials are impregnated with moisture-proofing materials such as paraffin, asphalts and oils, they readily absorb sufficient moisture in wet locations to completely lose their insulating properties. Such insulations must therefore be protected by a moisture-proof sheath such as lead when used in moist locations.

The insulations made from materials appearing in the first group fall into two general classes depending on whether or not they are vulcanized after application to the conductor, namely, (1) thermosetting insulations, those which are vulcanized and, (2) thermoplastic, those that are not vulcanized. Thermosetting insulations are those made from natural rubber, GR-S, butyl and silicone synthetic rubbers. Such insulations are applied to the conductor in a soft plastic condition and attain their ultimate physical properties as a result of a heat treatment (vulcanization) during which the sulfur or vulcanizing agents combine with the rubber. Thermoplastic insulations become plastic enough for application to the conductor simply by raising their temperature. They acquire their toughness again on cooling. From this it follows that thermosetting insulations are less subject to softening at elevated temperatures than thermoplastic insulations.

UNITED STATES RUBBER COMPANY

electrical wires and cables

Natural rubber, including Laytex®, GR-S synthetic rubber and thermoplastic insulations are available in two classes, depending on whether they are designed for use in dry or wet locations. Standard insulations, Type R and Laytex Type RU (made from rubber) and Type T (made from thermoplastic) are for use in dry locations while moisture-resistant insulations Types RW, RUW, and TW are for use in wet locations. There are many installations, particularly in buildings, where the less costly standard compounds give entirely satisfactory service.

Natural rubber and GR-S synthetic rubber insulations are also available in two classes depending on the operating temperature for which they are designed, namely, Type R and RW for 60 C. operation and Type RH and RUH for 75 C. operation. Conductors insulated with RH insulation carry more current, that is, use the conductor more efficiently than those insulated with Type R insulation. There is also available a combination insulation capable of operating at 60 C. in wet locations and 75 C. in dry locations. Butyl rubber insulation is suitable for operation at 80 C. and silicone rubber for even higher temperatures.

The thermoplastic insulations described above are limited to 600 volts for general power distribution. The rubber and rubber-like insulations are limited to a maximum operating voltage of 5000. For operation at higher voltages where ozone is produced in quantity, resistance to ozone in the insulation must be provided.

Acceptable ozone resistance in rubber and GR-S synthetic rubber insulations is provided by incorporating in them relatively high percentages of an inert or chemically saturated compound such as vulcanized vegetable oil. These are the so-called oil base compounds. Compounds made from butyl rubber are inherently ozone resistant. Oil base and butyl compounds are suitable for operation at a maximum voltage of about 28 KV, grounded neutral, when properly shielded.

Varnished cambric insulated cables are generally used in the same voltage range as ozone resistant rubber, that is, at a maximum of 28 KV, grounded neutral, and at a maximum conductor temperature of 85 C. For use in wet locations varnished cambric cables must be covered with a lead sheath.

Impregnated paper-insulated, lead-covered cables are suitable for operation at voltages up to 69 KV at a maximum temperature of 85 C. Gas or oil filled paper insulated cables are suitable for higher voltage services at somewhat reduced temperatures.

Insulation thicknesses for all insulations depend on the rated voltage, the conductor size and type of insulation. Minimum insulation resistance and test voltages have been established for all classifications.

For reprints of these pages write to address below.

Electrical Wire and Cable Department
Rockefeller Center • New York 20, N.Y.

Alumni Engineers

(*Continued from page 27*)

Russell F. Greenawalt, M.E. '34, has left General Foods Corp. and is in the industrial engineering department of Eastman Kodak Co. He lives in Rochester at 59 Park Lane.

Joseph Griesedieck, B.S. in A.E. (M.E.) '40, was elected president of Falstaff Brewing Corporation, St. Louis. He succeeds his father, Alvin Griesedieck, '16, who was elected chairman of the board. The 34-year-old president thus became the third generation member of his family to head the brewing concern which, with five plants and a 24-state sales area, ranks among the nation's top ten firms in the industry.

George A. Just, Jr., B.E.E. '43, senior engineer with Philco Corp. in Philadelphia, Pa., received one of the company's annual achievement awards from Barry Hardy, president of the television and radio division. Just joined Philco in 1947 and has done outstanding work in the design effort that produced the current PT Multiwave line. His home is at 9816 Woodfern Road, Bustleton, Pa.

Sanford J. Klion, '46, B.M.E. '47, received his professional engineer license in February, 1952, and lives with his wife and daughter, Jill, born February 13, 1953, at 400 East Fifty-ninth Street, New York City. His brother is **Franklin M. Klion '54.**

Claude A. Roichel-Kagan, '46, B.M.E. '49, B.E.E. '50, M.S., completed twenty-one months active military duty in Europe and recently returned to his home at 1212 Fifth Avenue, New York City.

B. Clifford Shaw, B. Chem.E. '48, has left Spencer Chemical Co. to become a senior chemical engineer at Midwest Research Institute, Kansas City 11, Mo.

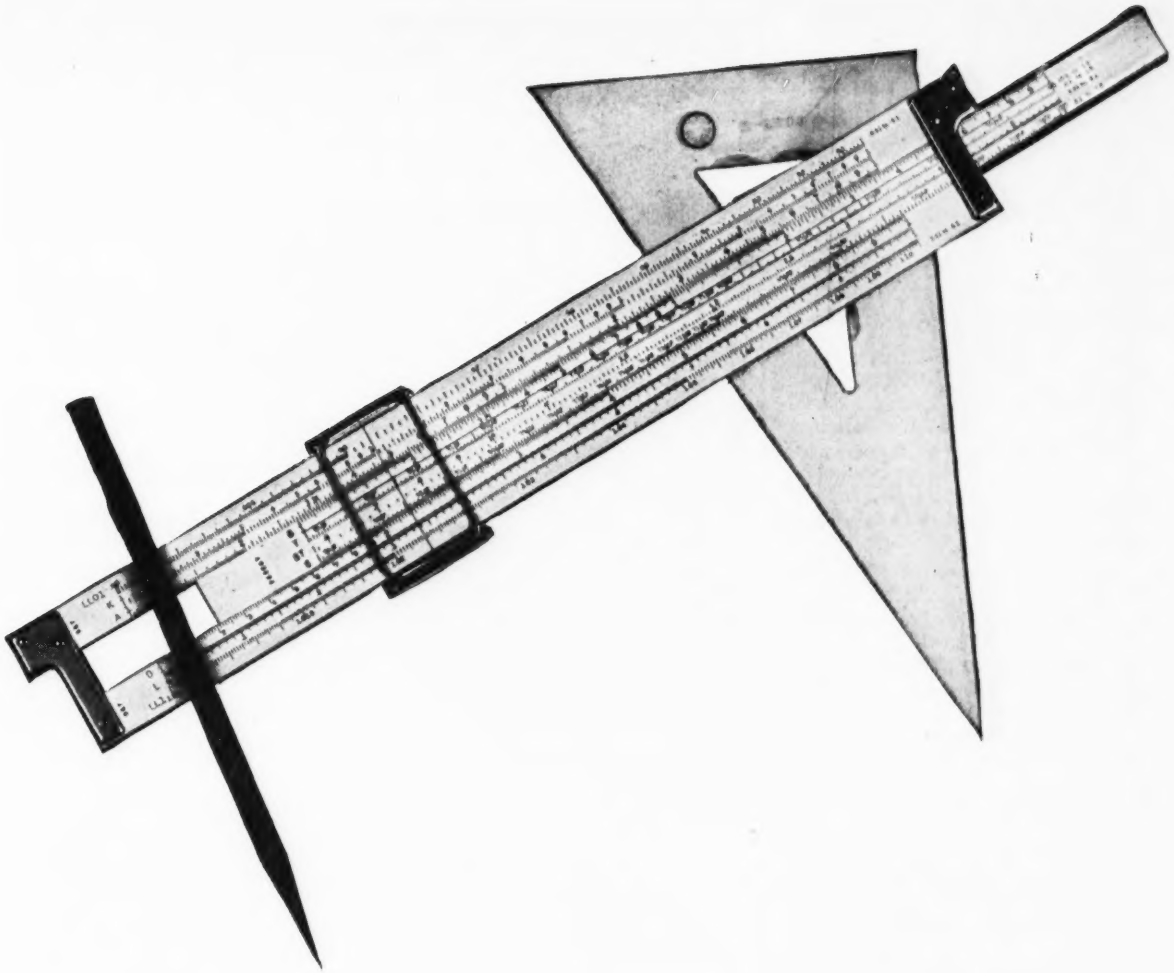
Lee H. Hill, Jr., B.E.E. '49, has been promoted by General Electric Co. to district transformer specialist for the Carolinas and Florida, after work in the engineering and commercial departments. He and his wife and Lee III live on Wonderwood Drive, Route 2, Charlotte, N.C.

Paul S. Nix, Jr., '50, B. Chem.E. '51 and Mrs. Nix **(Joan Dreger, '49)** have purchased a new home at 564 Willow Avenue, Scotch Plains, N. J. They have a son, Paul S. Nix III, seven months old. Mr. Nix is at M. W. Kellogg Co. Research Laboratory in Jersey City, N. J.

David H. Blauvelt, B.E.E. '50, M.E.E. '53, is employed as an assistant project engineer in the Flight Instruments Engineering Department of Sperry Gyroscope Company. Blauvelt is a member of Tau Beta Pi and Eta Kappa Nu.

Joseph M. Carter, B.M.E. '50, has been promoted in his research engineering in the power plant unit of Boeing Airplane Co. He writes that he is enjoying the skiing season from Thanksgiving to June and an occasional trip to Sun Valley, Idaho, from his home 1061 East Mercer Street, Seattle, Wash.

Second Lieutenant **Edward F. Southworth, '51, B.M.E. '52,** is stationed at White Sands, N. Mex., Proving Grounds, where he works on guided missiles.



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Men from more than 120 top engineering schools are building rewarding careers at Boeing. So chances are, you'd be working with some of your classmates here. And in addition you'd be a member of an Engineering Division renowned for its trail-blazing contributions to both military and civil aviation.

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- Advanced development and design of AM and FM broadcast transmitters, R-F induction heating, mobile communications equipment, relay systems.
- Design of component parts such as coils, loudspeakers, capacitors.
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Profile

CULVER SMITH

Interested in a summer job in Alaska, the Adirondacks, Yellowstone National Park? Would you like to sell beer, work on a production line, be a summer camp counselor? If so, the man to see is Culver A. Smith, University Employment Counselor in the Office of the Dean of Men. Mr. Smith will gladly give you all the available information about these and a multitude of other summer employment opportunities to which he has access. He will also make sure that the job measures up to both your standards and capabilities before even suggesting it.

Throughout the University, Mr. Smith's position is unique. His is the only office which places male students from all the different colleges in summer and full-time employment. One would think that this function would take up just about every minute of his working day, but Mr. Smith also finds time for other University services. Among these are placing students in part-time employment during the school year, administering student loans, formulating a budget of expenses for prospective students and acting as registrar and adviser for selective service.

However, as Mr. Smith explains it, his office acts primarily as a control coordinating bureau in the Office of the Dean of Men and as a liaison between campus, resorts and industry. It actively solicits summer jobs of all kinds, arranges campus interviews for company representatives, administers tests and cooperates with other university personnel departments so that the students and outside business organizations may be brought together in the best possible manner. Letters are also written to all faculty employers twice each year requesting that any help which they desire be obtained through Mr. Smith's office. Individuals wishing employment are then informed about the part-time and full-time opportunities available by means of personal notes, telephone calls, notices on bulletin boards and announcements in the *Cornell Daily Sun*.

Culver Smith and Lois Murray

Seldom mentioning himself or his duties, Mr. Smith usually speaks of "his office" or "the office," and gives a great deal of credit for its successful administration and smooth coordination to his secretary, Miss Lois Murray. She is his only full-time assistant, although he has some part-time student help for general office duties.

In operating his office, Mr. Smith maintains that a cooperative, friendly attitude with both students and other administrative officers is the best and most efficient way to get things done. He also stresses an amicable relationship among his assistants, and upon entering his office one is immediately put at ease by the friendly attitude which prevails. He makes no appointments with students, but rather operates under a "come and see me when you can" philosophy.

In 1946, Mr. Smith replaced Herbert H. Williams, '25, as director of the University Placement Service, when the latter resigned to become University Director of Admissions. At that time, headquarters of the Placement Service, as the bureau was then called, were in Willard Straight Hall.

No stranger to the Placement Service, Mr. Smith became affiliated in 1935, after experience in the credit offices of Henry L. Doherty and Company and the National Bank of New York City, and the B. F. Goodrich Company in New Jersey, where he was assistant credit manager. He joined the Placement Bureau to take charge of the National Youth Administration work program in the University and to direct other employment services for students. He was named assistant director of the Placement Service in 1942, taking charge of the staff of the Ithaca office.

A native of New Jersey, Mr. Smith entered Cornell's College of Arts and Sciences in 1922 from Newark Academy. He left in February, 1925, later taking courses at the American Institute of Banking and at Pace Institute, New York. During his undergraduate years at Cornell, he was a member of Phi Kappa Psi fraternity; he is at present alumni secretary of the Phi Kappa Psi Association. A member of the Ithaca Rotary, Mr. Smith is also a past director of Algonquin Lodge, which operates a student dormitory on Stewart Avenue. During the war years, he worked nights at the Morse Chain Company.

Away from the University, Mr. Smith does his best to lead a quiet, ordinary life. A year-round resident of Ithaca, he is married and makes his home near the campus. His hobbies include tennis, hiking and color photography, although he confesses he is playing less tennis now than in former years. His wife's favorite pastime is painting. When vacation time rolls around, they often travel to South Carolina, the Rocky Mountains or some other spot where both can take advantage of the scenic surroundings.

From his days as an undergraduate to the present time, Mr. Smith has always had the best interests of Cornell at heart. Since his return, as a member of the administration, he has become part of the Cornell tradition and has contributed greatly to the activities of the University.

Divining Rod

(*Continued from page* 19)

Summarizing the dowsing situation, we find an overwhelming amount of evidence in favor of the existence of some principle or principles which are responsible for the dowsers' ability. Results have been conclusive enough to prompt the British government at one time to establish an office, Walter Diviner to the Government. The man who filled this post, Major C. A. Pogson, achieved a record of 97 per cent accuracy in locating well sites in subnormally dry areas of India.

The formulation of an acceptable theory is hindered by non-uniformity of practice by the growing number of dowsers. The solution of the dowsing phenomenon depends upon accurate inspection of the vast amount of claims and discrimination of false information from useful data. The successes of science in the 20th century offer great hope for an answer to the professional dowser's questionable methods. Until that time the layman will continue to view the dowser with skepticism and amazement.

AIR MUSCLE...

Properly compressed and coupled to this drilling tool, air packs a rock-busting wallop. How different from the days when men slung sledges, and even cracking pavement was a slow, tortuous task . . . as were many other manual jobs in industry.

MIND OVER MUSCLE...

When men of science learned how to put a cyclone in a cylinder, pneumatic tools and compressed air became salient servants in saving men's muscles and industry's time.

In its more than two hundred applications compressed air cleans, sprays, operates machines for hoisting, hauling, hammering, drilling, cutting, grinding, blowing, pumping. Applied in free or enclosed action this versatile, conveniently-conveyable power agent may be found at work in mines and mills, on highways and skyways, on and under the water, in production and processing.

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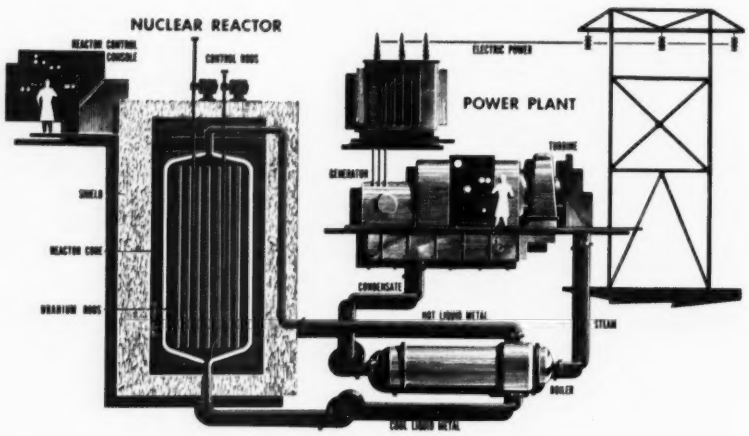
HEADQUARTERS FOR TECHNICAL AND BUSINESS INFORMATION

TECHNIBRIEFS

A simple television camera attachment that can be combined with any standard TV receiver to extend human sight in businesses, schools and homes has been demonstrated by RCA.

The camera contains a Vidicon pickup tube and a three-tube signal amplifier. The camera is about the size and weight of a 16-mm motion picture camera. All power requirements and the signal pulses which control the scanning action of the camera are taken from the receiver through adapters placed between the tubes and their sockets.

A standard receiver used with the camera for closed-circuit purposes may be returned to regular TV broadcast reception in a moment. The quality of the observed picture is claimed to be limited only by the normal picture reproducing quality of the receiver itself.



Shown above is a proposed atomic energy reactor capable of producing electricity for peace-time use.

Atomic Power

North American Aviation has designed an atomic power generator and is ready to build a pilot plant to demonstrate and study the production of electrical power for industrial and domestic consumption. Early in 1948 under contract with the Atomic Energy Commission, intensified work began in the general field of nuclear reactor technology. The goal of the recent work has been to develop nuclear reactors for the practical production of power.

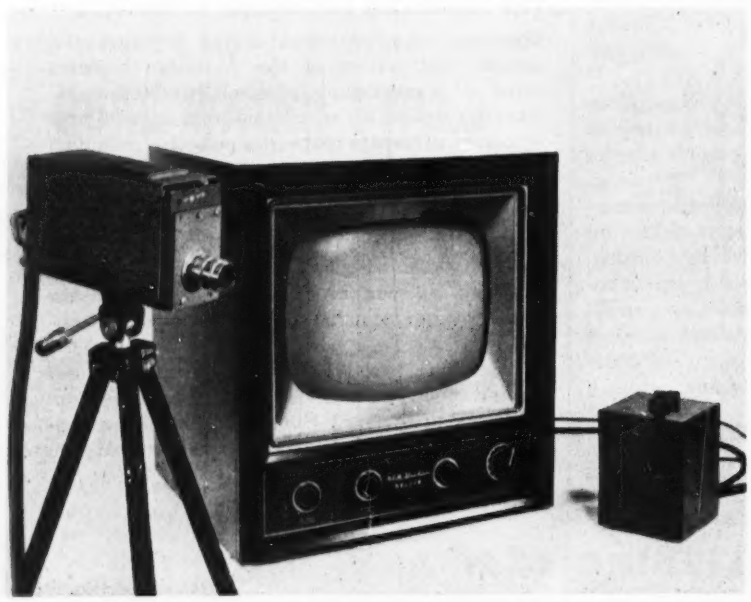
The proposed $10,000,000 pilot plant would generate about 8,000 kilowatts of electrical power, enough to supply 2,000 average homes with electricity. This power could be utilized for other atomic energy research to be done at the site of the reactor.

Electrical power would be generated in the pilot plant from the tremendous quantity of heat produced by the atomic fission process. This heat would be absorbed by a liquid metal passing through the reactor and would be piped into an ordinary water boiler to produce steam. The steam would then be used to drive a turbine-generator combination such as those owned by conventional power plants to produce electricity.

Externally, the pilot plant would resemble an ordinary electrical power plant, except for lack of coal, oil, or other similar fuel handling equipment. Unlike the present conventional installations, there would be no smoke or fumes.

While the cost of producing electricity from atomic fission is at present higher than the conventional methods, more nearly com-

(*Continued on page* 40)



This is the simple television camera which can be attached to any television set to form a convenient closed-circuit television system for the home, schools and business establishments.

What in the world are silicones?

These astounding chemicals—born of sand and oil—hate water, laugh at heat and cold, and are doing remarkable things for you and industry

SILICONES are the fabulous offspring of an unusual chemical marriage between sand and oil. Sand, the basic material for glass, gives silicones some of the best features of glass. Oil, source of many plastics, gives silicones some of the special qualities that have made plastics so useful to all of us.

WIPE ON . . . WIPE OFF—Silicones are the secret of the new, long-lasting automobile and furniture polishes that you simply wipe on and wipe off. Another silicone forms a water-tight bond between tough glass fibers and plastics that go into radar domes for airplanes, boat hulls, even washing machine parts.

WHEN APPLIED TO MASONRY WALLS, silicones are at their amazing best. A one-way street for water, they keep rainwater from penetrating, yet let inside moisture out!

THEY LAUGH AT HEAT AND COLD—Heat-resistant silicone insulation protects electric motors at high temperatures. Yet silicone insulation on jet plane wiring remains flexible, even in the brutal cold of the stratosphere. And silicone oils and greases withstand both arctic cold and tropic heat!

SILICONES AND THE FUTURE—Even the scientists don't know all the answers about silicones. But they do know there is an exciting future ahead for them. The people of Union Carbide, who pioneered in many of the special silicones now used by industry, are helping to bring that future closer to all of us.

STUDENTS and STUDENT ADVISERS: *Learn more about the many fields in which Union Carbide offers career opportunities. Write for the free illustrated booklet "Products and Processes" which describes the various activities of UCC in the fields of* ALLOYS, CARBONS, CHEMICALS, GASES, *and* PLASTICS. *Ask for booklet G-2.*

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Technibriefs

(*Continued from page* 38)

petitive methods of power production from atomic energy are expected to be developed through research with such a pilot plant. In areas where fuels such as coal, oil, gas and water power are not economically available, atomic power plants would have a distinct advantage over conventional installations.

Niagara Tunnel

The Canadians are building the largest long tunnels in the world under Niagara Falls, Ontario, and in the process are bringing new advances, new techniques and new achievements to the art of tunneling construction methods and equipment. The twin tunnels, 5.4 miles long with bores 51 feet in diameter, are part of Canada's project to divert additional water from the Falls for hydro-electric power generation.

The heading-and-bench method of driving is being used to dig out the tunnels. First a little more than half the tunnel is dug out horizontally; then from the bench, or floor of this section, the bottom half is drilled vertically.

An unusual method of drilling and shooting down from the bench has been developed for these tunnels. Key to the operation is a platform spanning the full width of the bench, from which are extended drifters to do the down drilling. The drill pattern is 12 or 13 holes spaced across the tunnel in rows every four feet. The depth of each row or holes can be figured to follow the circular bottom contour of the bench. Secondary eight-foot holes in another four by four pattern are staggered both ways between the first holes so that the bench can be broken into blocks small enough to handle.

Silicon Transistors

Development of a process for manufacturing pure silicon, which may lead the way to more powerful and less bulky television, radio and other electronic and electrical equipment, has been announced by the Du Pont Company. By this process, the company has opened up a large source of the material —a non-metallic element—for transistors as well as rectifiers and probably other electrical parts. Furthermore, silicon is expected to broaden the scope of these developments because it works over a much wider temperature range than other materials available.

The present price tag is $430 a pound—but a pound goes far in transistor construction. The silicon in a transistor wafer costs from two to four cents.

Germanium has been used in transistors, but recent tests indicate that pure silicon will compete with it in some uses; for many purposes silicon is the only known material that will work. This is particularly true where temperatures of more than 170 degrees Fahrenheit are involved. Silicon functions up to at least 400 degrees Fahrenheit, which means that it not only can withstand more surrounding heat but can handle more power than other materials. It can handle several times as much power as germanium, for example. Properties of silicon indicate that it may bring greater accuracy and precision to electronics equipment. Another potentially important factor is that silicon is one of the most common elements in the earth's crust, in contrast to germanium, which is extremely rare.

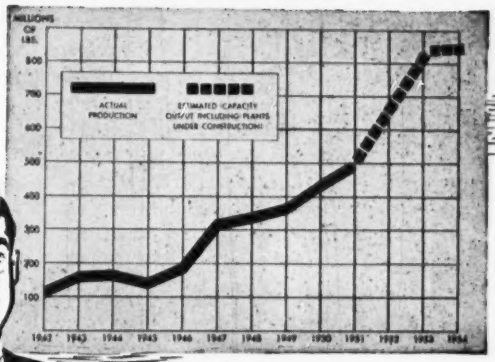
In rectifiers silicon would compete with selenium. The ability of silicon to withstand heat and handle greater power could mean smaller rectifiers with more capacity.

Robot Psychologist

A "robot psychologist" with an electronic brain, memory, and "show window" viewing screen is helping human psychologists "see" that the right man gets the right Army job.

The huge two-and-one-half ton, double-section electronic computer is known as a psychological matrix rotator. It was developed by engineers of the General Electric

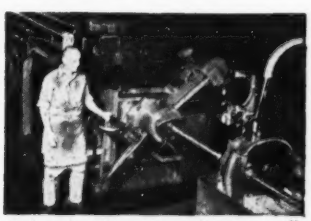
(*Continued on page* 42)



Reynolds expanding production —historic chapter in 33 years of continuing growth.

A Fertile Place for Careers to Grow...

Settling tanks, where impurities are separated from sodium aluminate



Tube drawing, one of many mill operations at Reynolds

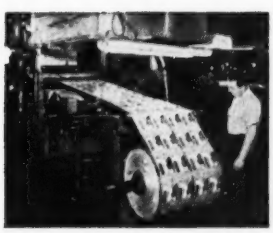
A broad vista of opportunity opens up for college graduates who come to work for Reynolds. The phenomenal rise of the Reynolds Metals Company, known throughout business and industry, is clearly depicted by the above chart. The five-fold expansion in total production of aluminum ingot alone spells broad opportunity. Add to this the vast and productive fabricating facilities of Reynolds —in themselves an enterprise of considerable proportions—and here indeed is a fertile field for any ambitious engineer.

From bauxite mining through metals refining and fabrication to application engineering, sales and marketing, Reynolds offers broad career opportunities. Operating 27 plants in 13 states, and still expanding, there is virtually no limit to what can be accomplished by a capable graduate engineer.

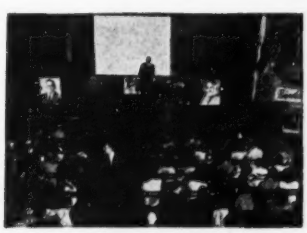
Preliminary orientation in production and sales...direct on-the-job training...liberal insurance, hospitalization and retirement programs...these are all parts of a sound personnel policy maintained at Reynolds.

For important information on "your future in Aluminum," *mail the coupon.* If you are definitely interested now, write direct to General Employment Manager, Reynolds Metals Company, 3rd and Grace Streets, Richmond 19, Va.

REYNOLDS ALUMINUM



Foil—for many uses, including colorful, protective packages and labels; also famous Reynolds Wrap.



Full color movies tell the fascinating story of Reynolds Aluminum. 16mm films available for group showings.

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Richmond 19, Virginia

Please send me, **FREE,** your 96-page booklet "The ABC's of Aluminum"; also the 44-page book, "Reynolds Aluminum ... and the Company that makes it."

Name_____

Address_____

School_____ **Class**_____ **Course**_____

Technibriefs

(*Continued from page 40*)

Company.

A step-by-step account of the machine's use in a typical problem might run as follows:

Psychologists first obtain information to be fed the machine by administering paper and pencil tests to various control groups of people, such as doctors, truck-drivers or mechanics. Each group is assumed to have individual talents or abilities such as manual dexterity, shape recognition, reasoning, etc.

Information thus received is translated into statistical form on a variety of other computing devices and fed into the "robot psychologist" for analyzing. A myriad of buttons, switches and dials sets the computer into operation to flash test results on a cathode-ray tube screen as a pattern of dots. The dot patterns are then studied for desired information.

Test patterns arranged in closely-clustered dots are assumed to describe similar underlying or inherent abilities among the various groups.

Dots obtained from statistical data of known groups are then used as a standard of comparison in determining what specific qualifications are needed for particular jobs. The patterns can then be used in mass psychological testing of new recruits.

Soil Stabilization

Electric current is being used to change treacherous wet soil into firm clay-like ground, easy to excavate. This is made possible by the phenomenon of electro-osmosis in which electric current when applied to water in capillaries moves from the positive to the negative pole "dragging" the water behind it.

This process of soil stabilization was recently used in open excavations near Bay City, Michigan. Units of a generating plant there are being erected on ground, the top 18 feet of which is saturated sand underlaid with 13 feet of sandy silt, then 19 feet of soft peaty silt and a deep layer of water-bearing sand. The site of the operation was only 40 feet away from the Saginaw River, but the electric current forced into the soil not only made it stable enough to excavate a trench 21 feet deep without support for embankments or further dewatering, but kept the river water out of the deep hole.

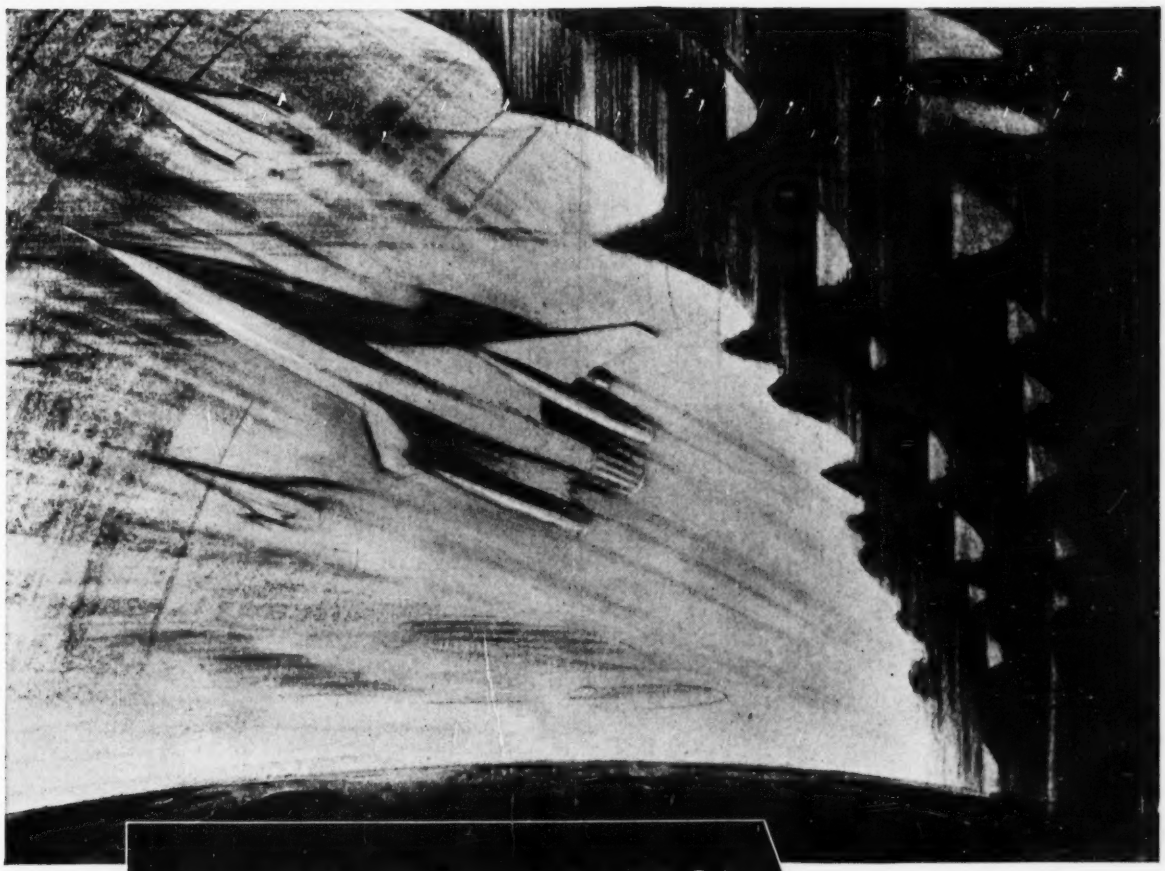
The method was developed by Dr. Leo Casagrande, who has used it on four previous occasions in Europe, the most notable of which was in stabilizing excavation for U-boat pens in Norway during the war.

At the plant site electric current from several motor generator sets was passed through the soil from positive pipe anodes to wellpoint cathodes driven around the perimeter of the 210x280 foot plot. If the negative cathode is open, as in this case, the water is forced into the pipe and up to the open top with unbelievable pressure. As the capillaries are freed of water, they shrink and the ground consolidates and becomes stabilized.

Weather Pen

A swift river of wind in the sky called the jet stream now can be detected in fair weather or foul by a "weather pen" that measures electric charges aloft. The jet stream builds a tell-tale positive charge that can be measured by a radioactive antenna installed on the roof of the General Electric Company's laboratory at Schenectady, N. Y. A sensitive photo-electric recorder then writes a continuous record of the electric potential in the sky.

The "weather pen," it is hoped, someday may do away with the need for sending expensive balloon-borne equipment aloft to find the location of the heavenly hurricane that often doubles the speed of high-flying planes. It now supplements the use of cloud observation as a means of establishing the presence of the swift corridor of winds.



BEYOND THE HORIZON....

Progress in reaction-motor propulsion becomes possible only as the metallurgist supplies new alloys to withstand the stresses, temperatures, and corrosive attack developed by new rocket fuels.

Molybdenum additions to many alloys are known to improve strength at high temperatures. For this reason Molybdenum will be used more and more in the reaction motors of the future.

Climax furnishes authoritative engineering data on Molybdenum applications.

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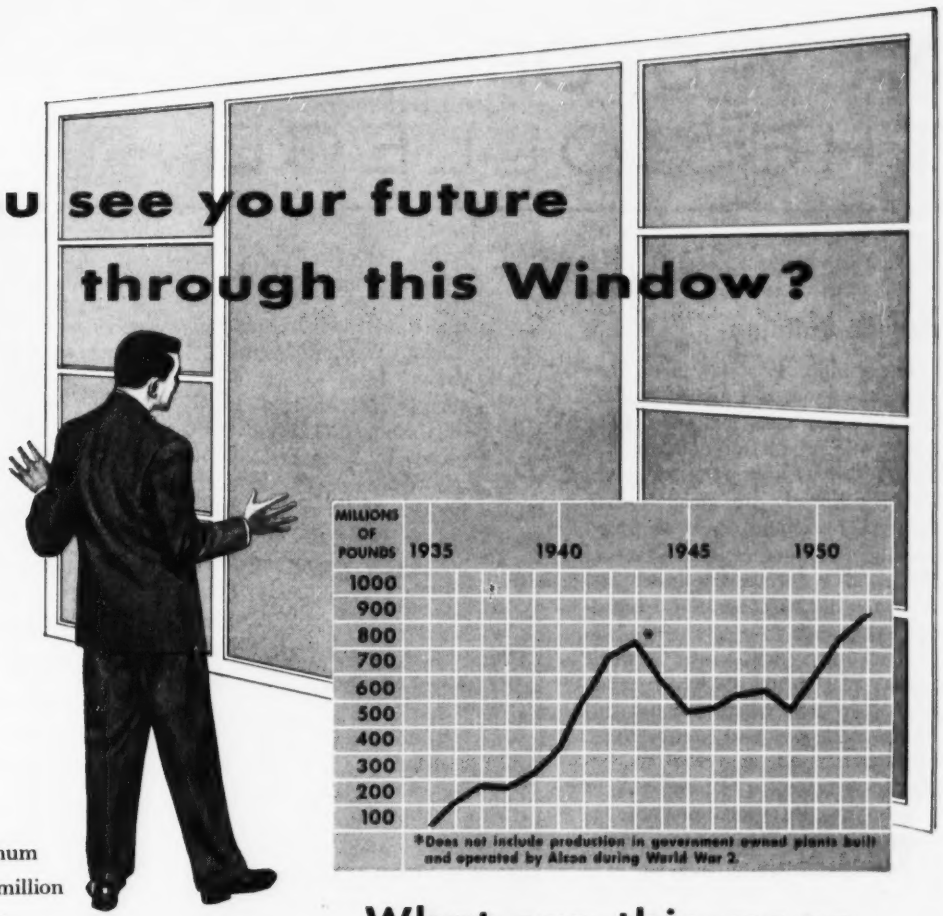
Can you see your future through this Window?



This is an aluminum window, one of four million that will go into buildings in 1953. Twenty years ago, it was just an idea in the mind of an Alcoa development engineer. Ten years ago, only a few thousand were made annually. Now, production *is increasing* at the rate of over half a million a year. This is just one of a torrent of new uses for aluminum which means that Alcoa must continue to expand. Consider the opportunities for you if you choose to grow with us.

What can this mean as a career for you?

This is a production chart . . . shows the millions of pounds of aluminum produced by Alcoa each year between 1935 and 1952. Good men did good work to create this record. You can work with these same men, learn from them and qualify yourself for continually developing opportunities. And that production curve—is still rising, we're still expanding, and opportunities for young men joining us now are almost limitless.

Ever-expanding Alcoa needs engineers, metallurgists, and technically minded "laymen" for production, research and sales positions. If you graduate soon, if you want to be with a dynamic company that's "going places", get in touch with us. Benefits are many, stability is a matter of proud record, *opportunities are unlimited.*

For more facts, consult your Placement Director. ALUMINUM COMPANY OF AMERICA, Pittsburgh, Penna.

Alcoa Aluminum

ALUMINUM COMPANY OF AMERICA

NEWS OF THE COLLEGE

New EE Building

The Phillips Foundation of New York has donated a gift of $1,200,000 for a new electrical engineering center at Cornell University.

The Phillips Foundation was created by Ellis L. Phillips, of Plandome, Long Island, a Cornell engineering alumnus of the Class of 1895 and a former president and chairman of the Long Island Lighting Company.

The building will house Cornell's School of Electrical Engineering, the oldest such school among American colleges and universities. Construction is expected to begin this year. The building will be erected at the south end of the campus to extend the new engineering group, which already includes Olin Hall of Chemical and Metallurgical Engineering and two engineering materials units, Kimball and Thurston Halls. It will stand between East Avenue and Hoy Field, south of Campus Road. Perkins & Will, of Chicago, are the architects. The structure will function both as a research center and as a classroom building.

A native of Naples, N. Y., Mr. Phillips is regarded as one of the early leaders in the electric utility field. Soon after receiving an electrical engineering degree at Cornell in 1895, he joined Westinghouse, Church, Kerr & Co. as an engineer in charge of design and construction. Thereafter he participated in a number of engineering enterprises through his engineering firm, E. L. Phillips & Co.

Assistant Dean

Professor J. E. Hedrick has been appointed the new assistant dean of the College of Engineering. Professor Hedrick joined Cornell's chemical engineering faculty in 1949 after eight years in the Shell organization, where he helped to design plants to manufacture synthetic rubber, aviation gasoline and chemicals.

As executive assistant in Shell Chemical Corporation from 1945-49, he helped to coordinate all the company's research and was technical adviser to its president. During World War II he was a War Production Board consultant on increasing the production of essential chemicals.

Ellis C. Phillips, donor of electrical engineering center.

Engineers' Banquet

Approximately one hundred students and faculty members attended the annual Engineer's Day Banquet at the Ithaca Country Club on April 26.

The banquet, sponsored by the Cornell Student Engineering Council, climaxed a weekend of engineering activity which began Friday night, April 24.

Guest speaker at the banquet was Professor William H. Erickson, who delivered a highly entertaining and informative address on engineering education. Professor Erickson cited the record achieved by Cornell engineers in industry and stressed the importance of "doing more than what is expected of you" in attaining success.

As is traditional at the banquet, awards for the best E-Day exhibits were presented in addition to those for outstanding scholastic and extracurricular achievement in the College of Engineering.

Cornell Aero Lab Joins Coop Program

Plans to participate in the Cornell University Engineering Industrial Cooperative Program, aimed at jointly promoting education and practical experience in engineering, were announced last spring by Cornell Aeronautical Laboratory, Inc.

Three promising engineering students have been selected for sponsorship in the study-work plan which began with summer sessions at the University this year. Under the program, alternate four-month periods will be spent in study at Cornell University and in actual research at the Buffalo Laboratory.

The students selected are Irwin M. Jacobs, EE, from Marion, Massachusetts; John L. Hayes, Jr., EE, from Washington, D. C.; and Joel B. Peterson,ME, from Summit, New Jersey. Each is in the class of 1956.

The Laboratory will sponsor three additional students each year so that following the first year there will be three engineering students continuously engaged at the Laboratory. They will be assigned to those projects in the Laboratory's research and development program that are similar to their academic interests.

The participants will receive salaries during their employment, and in addition, the Laboratory will pay the University $350 for each student-term spent in the Laboratory.

This fee covers tuition costs for the co-op student while at the University.

Those selected start the Cooperative Program in their third year of Cornell's five-year engineering curriculum and complete it at the end of their fourth year. By utilizing their summers, they are able to engage in three industrial work periods without delaying their graduation date.

Cornell Aeronautical Laboratory, Inc., becomes the sixth organization to enter Cornell University's Engineering Industrial Cooperative Program. The others are Philco Corporation, General Electric Corporation, Air Reduction Company, Proctor and Gamble Company, and American Gas and Electric Service Corporation. The program was initiated in 1947.

Bishop Wins Fuertes Medal

Wallace K. Bishop received last year's Fuertes Medal given to the Cornell civil engineering student with the highest scholastic average at the beginning of his last term of undergraduate work at the University.

Study Military Vacuum Tube Failures

Vacuum tube failure can knock out radios, radar sets and other electronic equipment. When the breakdowns occur in military use, the consequences are particularly serious.

The failure problem is getting close attention at Cornell University, where a team of electrical engineers is studying hundreds of burned-out and otherwise defective tubes sent here from military installations the world over.

The investigation, started in June of 1951, is being conducted for the three services through the Army Signal Corps. It is expected to lead to the production of more reliable tubes. Professor Walter R. Jones, former chief engineer with Sylvania Electric Products, Inc., heads the project.

The defective tubes arrive at Cornell as carefully wrapped as Christmas tree ornaments. Each tube is given a series of electrical and visual tests to determine the exact nature of the failure.

Information obtained from tests is correlated with a "history" telling where the tube came from, how it

Inspecting vacuum tubes in the military tube laboratory.

was used, and how long it performed before giving out. From this come recommendations for changes in circuits using the tubes, in operating procedures, and in the design and manufacture of the tubes themselves.

So far, several thousand tubes have reached the laboratory in Cornell's School of Electrical Engineering. Most of the testing apparatus was specially designed for the project by Professor Jones and his associates.

In addition to the military specimens, production-line rejects from various manufacturers are also undergoing study. Eventually, it is hoped, Cornell will establish a "tube library" to which manufacturers under government contract can turn to draw carefully calibrated tubes for building and testing their products.

Dr. William R. Sears

Dr. William R. Sears, director of Cornell's Graduate School of Aeronautical Engineering, has been named to the Naval Research Advisory Committee, the senior research advisory group of the U.S. Navy Department.

The committee studies questions of policy in Navy-wide problems in science and advises the Secretary of the Navy, the Chief of Naval Operations and the Chief of Naval Research. Its members are also called upon as consultants on particular technical problems.

Dr. Sears also serves on the subcommittee on fluid mechanics of the National Advisory Committee for Aeronautics.

Scholarships

Names of twenty-six recipients of the first Alfred P. Sloan National Scholarship awards have been announced by the Sloan Foundation. Included are those of six students who enter the College of Engineering at Cornell University this fall.

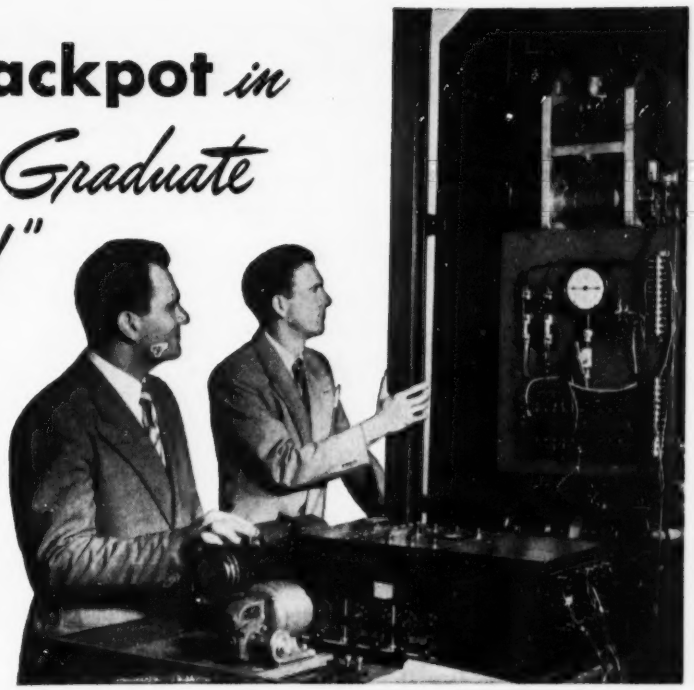
The scholarships, carrying a maximum stipend of $2,000, were established recently by the Sloan Foundation for study at Cornell and at California, Carnegie and Massachusetts Institutes of Technology. They are awarded without regard for economic background to youths who have shown scientific promise and capacity for leadership.

Those who enter Cornell this fall are: Jeffrey A. Gorman from Westminster, Mass., CE; Keith R. Kleckner, Cleveland, Ohio, EE; Maurice J. Mahoney, Pittsburgh, Pa., ChemE; Lawrence C. Teel, Palmer, Mass., ME; Richard N. Tillman, Minneapolis, Minn., ChemE; and Charles R. Yoh, Milwaukee, Wis., ChemE.

Cornell's three Monsanto Chemical Company Scholarships for this academic year have been awarded to Mathias van Thiel, Elliot R. Cattarulla and Robert A. Vanderhoek, who are beginning their senior year at the University.

The annual scholarships pay full tuition of $700 to a senior in the College of Arts and Sciences who is majoring in chemistry, a fifth-year chemical engineering student in the School of Chemical and Metallurgical Engineering, and a fifth-year student in the School of Mechanical Engineering.

"We Hit the Jackpot *in Allis-Chalmers Graduate Training Course!*"



say N. W. MORELLI

Oregon State College, B.S., M.E.—1950

and

E. R. PERRY

Texas A. & M., B.S., E.E.—1950

WHILE taking the course, two engineers developed a revolutionary new circuit breaker mechanism.

"Our experience shows what *can* happen if you work with people open to suggestion. We found men of this kind at Allis-Chalmers, and it has given us a special pleasure in our job.

"We started out like most other graduates with a hazy idea of what we wanted to do. After working in several departments, we requested that part of our training be at the Boston Works of Allis-Chalmers, where circuit breakers are made."

New Design Principle

"Circuit breakers soon became an obsession with us, and we got the idea of designing a hydraulic operator and triggering mechanism for these breakers. Most operators for big breakers are pneumatic.

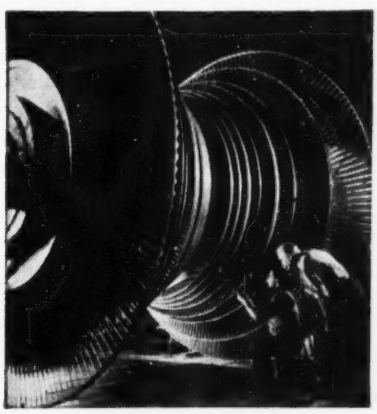
"Unsuccessful attempts had been made in the past by all circuit breaker manufacturers to build hydraulic operators. The important thing is that no one at Allis-Chalmers said, 'Don't try it—it won't work.' "

Start New Era

"To make a long story short, our study of the problem led us to the hydraulic accumulator and high speed valves being used by the aircraft industry. These had not been available when earlier attempts were made to build a hydraulic operator. With these highly developed devices to work with, we were able to build an operator that combined the best features of pneumatic and hydraulic operation. We call it the *Pneu-draulic* operator. Engineers are saying it starts a new era in circuit breaker actuation.

"This fact is important to us, but it is even more important to know that Allis-Chalmers Graduate Training Course is full of opportunity . . . and as we found out, there's opportunity right from the start."

Pneu-draulic is an Allis-Chalmers Trademark.



Low-pressure spindle for a 120,000 kw steam turbine generator. Said to be one of the largest ever built in the United States, this spindle is nearing completion in the Allis-Chalmers West Allis shops.

Facts You Should Know About the Allis-Chalmers Graduate Training Course

1. It's well established, having been started in 1904. A large percentage of the management group are graduates of the course.

2. The course offers a maximum of 24 months' training.

3. The graduate engineer may choose the kind of work he wants to do: design, engineering, research, production, sales, erection, service, etc.

4. He may choose the kind of power, processing, or specialized equipment with which he will work, such as: steam or hydraulic turbo-generators, circuit breakers, unit substations, transformers, motors, control, pumps, kilns, coolers, rod and ball mills, crushers, vibrating screens, rectifiers, induction and dielectric heaters, grain mills, sifters, etc.

5. He will have individual attention and guidance in working out his training program.

6. The program has as its objective the right job for the right man. As he gets experience in different training locations he can alter his course of training to match changing interests.

7. For information watch for the Allis-Chalmers representative visiting your campus, or call an Allis-Chalmers district office, or write Graduate Training Section, Allis-Chalmers, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS AC ALLIS-CHALMERS C-5675

Materials Center Dedicated

The dedication of Kimball and Thurston Halls on June 13 was attended by some 500 faculty members, alumni, and students. Dean Hollister presided at the ceremonies held in the four-story, cube-shaped testing chamber in Thurston Hall. In his opening remarks he referred to the purpose of the dedication in honoring two of the great engineers and teachers in Cornell's history—Robert Henry Thurston, first director of the Sibley College of Mechanical Engineering, and Dexter Simpson Kimball, first dean of the College of Engineering.

Honored guests were Mrs. J. Rea Patterson, daughter of Dr. Thurston, and Wallace M. Patterson, M.E. '38, her son; and also members of the Kimball family—Dexter S. Kimball, Jr., M.E. '28, George N. Kimball, Arch. '35, and Isabel Kimball Cramer, sons and daughter of Dean Kimball, and the two young sons of Dexter S. Kimball, Jr.

The portrait of Dean Kimball, painted in the year before his death last November 1, and presented by trustee Mr. Walker Cisler at a reception in Dean Kimball's honor last spring, was on display at the dedication ceremonies. A companion portrait of Dr. Thurston by the same artist, Thomas E. Stephens of New York, was presented to the University during the dedication ceremonies by Mr. Maxwell M. Upson. Mr. Upson was a student of both Thurston and Kimball and is presently a trustee of the University.

Mr. Upson referred to his educational experience under Dr. Thurston as a rare privilege. He spoke of Thurston's unusual kindness and understanding of the young student and of his inspirational qualities of teaching. He credited him for being among the first to foresee the marriage of science with the practical mechanic arts to bring about the professional engineering practice of today. Presenting the portrait in his own name and that of Mr. Arthur Dean, chairman of the executive committee of the board of trustees, Mr. Upson mentioned that Mr. Dean had insisted that he be permitted to participate in the commissioning because of the influence of Dr. Thurston on his father.

Dean Hollister called upon President Malott to dedicate the two buildings. The President stated that the buildings would be dedicated to the high purpose of the College of Engineering, particularly in the fields of materials processing and materials testing, "out on the vanguard of our changing technology." He remarked that beyond the steel and concrete and glass there was built into the structures the character and integrity of two of the great personalities of Cornell.

President Malott acknowledged Dean S. C. Hollister as "a great master builder, who is carrying on the traditions established by those before him and is constantly adding to the strength and forward progress of the College."

Mr. Walker Cisler, chairman of the sponsoring committee for the buildings and trustee of the University, expressed his grateful thanks to all who participated in bringing the buildings into being. He referred to members of the University organization and particularly to the members of his committee, who exerted considerable effort to reach a successful conclusion in the fund raising activities.

On behalf of the sponsoring committee, he stated that the accomplishment of the structures would live long in the memories of all of those who had had a part in bringing them about, because they represented so much of the human relationship that had been established between teacher and student and that now was being given tangible form in these halls.

Maxwell M. Upson speaks at dedication of Kimball and Thurston Halls. Flanked by portraits of Dean S. C. Hollister and Thurston are (left to right) Walker L. Cisler, Mrs. Patterson, Mr. Patterson, George N. Kimball, Dean Hollister, President Malott, Dexter S. Kimball, Jr., Mrs. Cramer, and Dexter S. Kimball, 3rd.

Mr. Cisler addressed his remarks to the present and very effective work of Dean Hollister in carrying on the program of the College of Engineering. He referred to Dean Hollister's reputation throughout the world in engineering education and to the high regard with which he is held in industry as well.

In appreciation for his work, Mr. Cisler then presented to the University a portrait of Dean Hollister which had been commissioned by himself, Mr. Maxwell Upson, Mr. J. Carlton Ward, both trustees and alumni, and Mr. Isaac Harter, an alumnus of the University of Pennsylvania and presently chairman of the Babcock and Wilcox Tube Company.

Dean Hollister closed the program with an invitation to inspect the various facilities of the buildings and to join in the alumni-faculty get-together held immediately afterwards in the testing bay.

Standing before the portraits of Robert Henry Thurston and Dexter S. Kimball are Mrs. Cramer, Mrs. Patterson, George Kimball, and Dexter Kimball, Jr.

What's Happening at CRUCIBLE

about Alnico Permanent Magnets

You will find Crucible Alnico Permanent Magnets in products ranging all the way from cuff links to magnatrons. Here are just a few unusual applications in which these magnets were used to simplify or improve a product.

This is Warren, age 4, a cerebral palsied youngster, using magnetic toys in therapy-play.

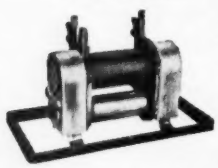
Magnetic Toys **Cerebral palsied youngsters at the Children's Rehabilitation Institute, Cockeysville, Maryland, are unable to play with normal toys. Their lack of muscular coordination and control, causes ordinary blocks or toys to slip through their grasp and fall to the floor. Crucible helped overcome this problem by imbedding small permanent magnets in the toys. By using these magnet-equipped toys on metal topped tables, the children are able to control them much more easily.**

The Children's Rehabilitation Institute has pioneered techniques to help these handicapped children gain maximum muscular control and coordination. Experience at the Institute has shown that the use of magnetized toys helps develop coordination in hand and arm use, and in grasping and releasing.

Cuff Links **One manufacturer of cuff links had a happy idea. He replaced the stem with a magnet assembly designed by Crucible magnet engineers. The tiny, powerful aspirin-sized magnets used, gave the finished product a holding force at the pole plate as high as 80 ounces troy.**

Enlarged cross section view of one cuff link.

Telescriber-Recorder **In one application, for this instrument that transmits written messages over wire, two permanent magnets were being used to match the electromagnetic fields. Assembly time and unit costs were high. Crucible magnet specialists designed one permanent Alnico magnet to replace the two. Magnet costs were cut 50% . . . and efficiency of the unit was increased.**



Top bar Crucible Alnico; lower bar (replacing former 2nd magnet) provides return path.

Engineering Service Available

Perhaps your magnet problems are entirely different from these. Whatever they may be, our staff of magnet and electronic engineers will be glad to tackle them, and to work with you in meeting your magnet requirements. Don't hesitate to call us when you have an application for permanent magnets.

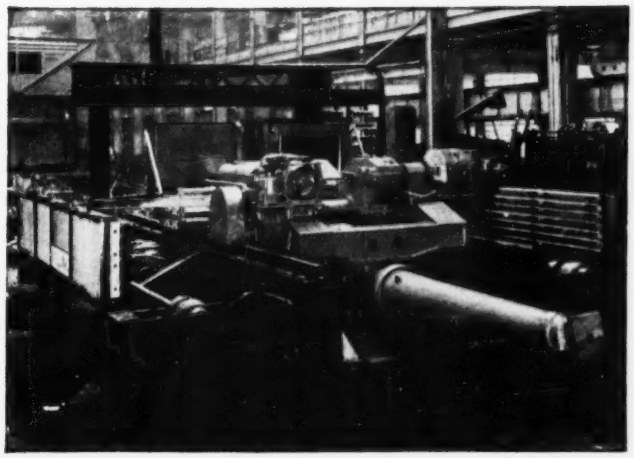
CRUCIBLE **first name in special purpose steels**

53 years of Fine steelmaking

CRUCIBLE STEEL COMPANY OF AMERICA, GENERAL SALES OFFICES, OLIVER BUILDING, PITTSBURGH, PA.

Midland Works, Midland, Pa. • Spaulding Works, Harrison, N. J. • Park Works, Pittsburgh, Pa. • Spring Works, Pittsburgh, Pa.
National Drawn Works, East Liverpool, Ohio • Sanderson-Halcomb Works, Syracuse, N. Y. • Trent Tube Company, East Troy, Wisconsin

Another page for **YOUR BEARING NOTEBOOK**

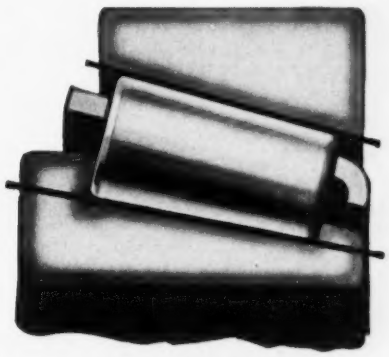


How to carry a floor charger's 12-ton overhung load

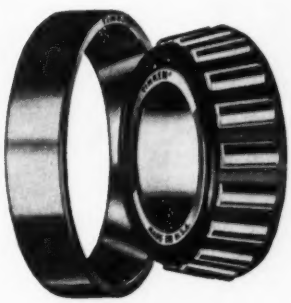
This floor charger charges and levels 12 tons at a crack in open hearth furnaces. The 12-ton overhung load and the terrific shock loads set up by the charging operation are carried by the peel shaft bearings. To take these loads and to keep the charger in top operating shape, design engineers specify Timken® tapered roller bearings.

Line contact gives TIMKEN® bearings extra load-carrying capacity

In Timken bearings, the load is carried on a line of contact between the rollers and races instead of being concentrated at a single point. Rollers and races are case-carburized to give a hard, wear-resistant surface over a tough, shock-resistant core. And to be sure of getting the highest quality bearing steel, the Timken Company makes its own.



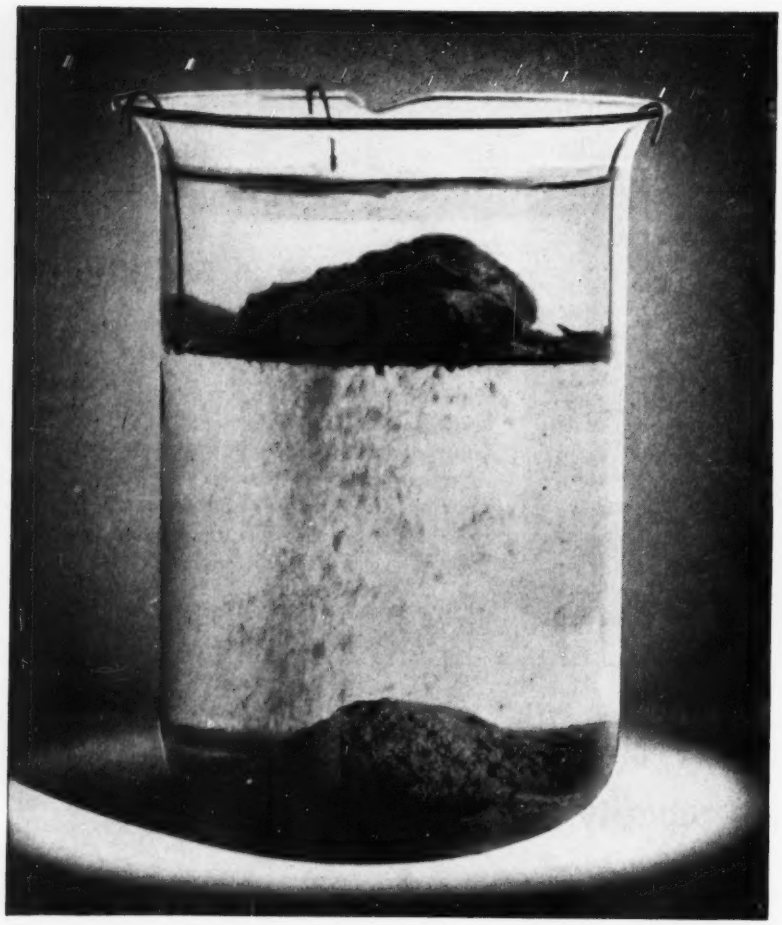
TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS



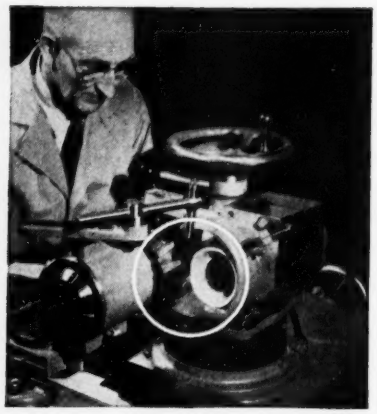
Want to learn more about bearings or job opportunities?

Many of the engineering problems you'll face after graduation will involve bearing applications. For help in learning more about bearings, write for the 270-page General Information Manual on Timken bearings. And for information about the excellent job opportunities at the Timken Company, write for a copy of "This Is Timken". The Timken Roller Bearing Company, Canton 6, Ohio.

NOT JUST A BALL ○ NOT JUST A ROLLER ⬭ THE TIMKEN TAPERED ROLLER BEARING TAKES RADIAL ⦶ AND THRUST —⦶— LOADS OR ANY COMBINATION ⦶



DEMONSTRATION . . . By a Norton-developed process, "32" ALUNDUM abrasive grains form in an electric furnace in a fluid mass. Each grain "grows" into a single crystal. As the matrix dissolves, the crystals are released — each one complete in itself, strong, hard and with many sharp points. No crushing is necessary.



TOOL GRINDING with a Norton ALUNDUM wheel is rapid . . . gives operators the "Touch of Gold" by better and more economical tool sharpening.

Dramatic step in giving grinding operators the

"TOUCH OF GOLD"

"32" ALUNDUM, a Norton development in abrasives*

Today grinding is not just a "cost" item. Every time a Norton grinding wheel comes in contact with a product being made, the operator has the "Touch of Gold" . . . adds to product value and usefulness . . . increases the profit margin.

Among the most revolutionary forward steps in grinding history was the development by Norton of "32" ALUNDUM abrasive. It set new standards for faster, more productive work on many types of grinding such as tool grinding, surface, internal, cylindrical, centerless grinding.

This is one of the ways we at Norton carry out the tradition of "Making better products to make other products better." Another is in the field of Special Refractories where Norton catalyst supports, seamless porous mediums, kiln furniture and furnace linings are helping industrial progress.

A career at Norton where engineers and technicians work in 19 specialized areas, would be interesting and productive. But wherever you work, bear in mind that Norton is the world's largest source of abrasives and abrasive products. For information write NORTON COMPANY, Worcester 6, Mass.

NORTON

Making better products to make other products better

Abrasive • Grinding Wheels • Pulpstones • Oilstones
Abrasive Paper and Cloth • Grinding and Lapping Machines • Non-Slip Flooring • Refractories • Boron Carbide Products

NORTON COMPANY
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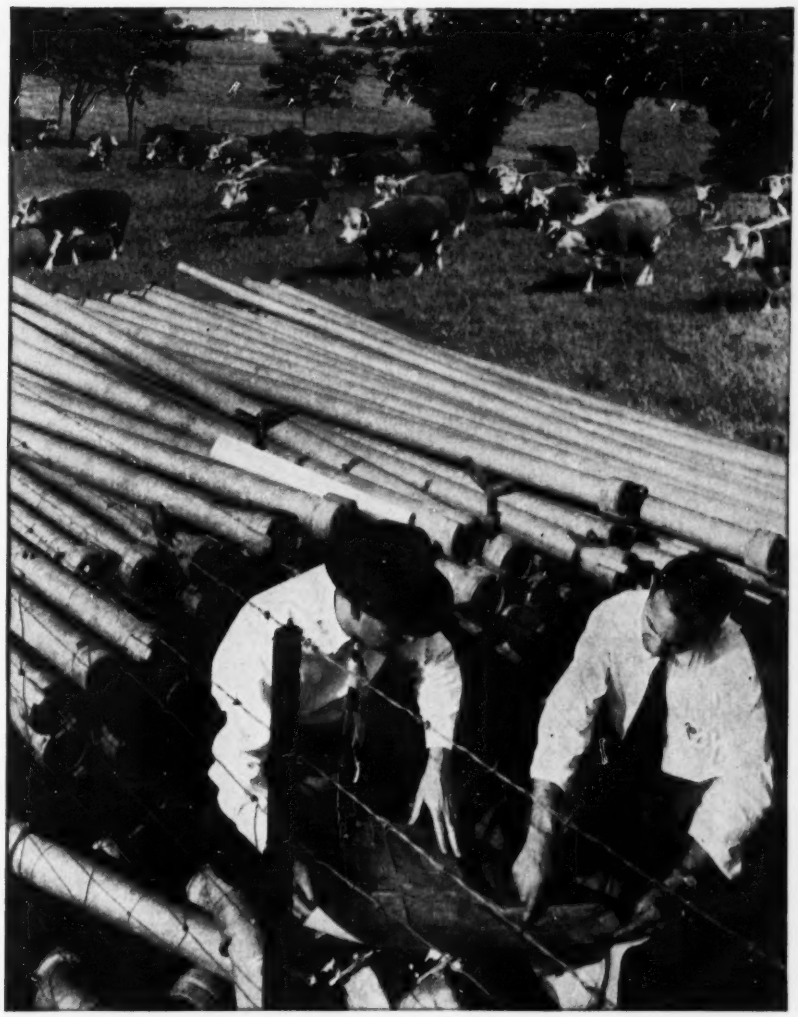
Behr-Manning, Troy, N. Y., Is A Division of Norton Company

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

Two agricultural scientists, from a large state university, check the blue print for irrigation pipe on Republic's experimental farm.



HERE THE CATTLE ARE GUINEA PIGS

If you're going into industry, one of your most difficult tasks faces you in the next few months. You'll have to distinguish between progressive companies and stand-stills. One way is to consider the pioneering each is doing.

How much does this company you might join plan its future?

How much does it care about society in general?

The cattle in the picture, for instance, are at Republic's experimental farm. They are part of a study to determine how much extra grass, hence extra meat, can be produced by irrigation. The purpose of the experiment is to prove the benefit of converting worn-out crop land to profitable grazing area.

The economic reasons for Republic's experiment are that animals must be fenced and Republic makes steel farm fence; also that irrigation requires pipe and Republic makes steel irrigation pipe. But beyond this immediate commercial aspect, Republic's experimental farm has a goal reaching far into the future.

Republic Steel's policy is based on a deep realization that no economic or social section of a nation can long progress at the expense of others. Progress must be mutual and industry has a responsibility to *do for* its customers as well as to *sell to* them. This, we believe, is an enlightened approach to economics which will promote the continuing welfare of all.

We hope such research programs, of which our farm experiments are only one example, will catalog Republic in your mind as a progressive, forward-thinking company.

REPUBLIC STEEL

GENERAL OFFICES • CLEVELAND 1, OHIO

REPUBLIC STEEL

WORLD'S WIDEST RANGE OF STEELS AND STEEL PRODUCTS

STRESS and STRAIN...

Ruth: "How do you know he was drunk?"

Doris: "Well, he shook the clothes tree and then started to feel around the floor for some apples."

* * *

Little girl to her mother: "Will I walk to Heaven on a golden bridge?—the minister said so."

"He's wrong, Dear, there are no bridges in Heaven—it takes engineers to build bridges."

* * *

Nurse (in insane asylum): "There is a man outside who wants to know if we have lost any male inmates."

Doctor: "Why?"

Nurse: "He says that someone has run off with his wife."

* * *

An engineer is a guy who is educated in the art of developing new and different ways of making the same mistake.

Two bopsters, smoking reefers, were suddenly thrown into a panic by the wail of a police siren. Not knowing if their apartment was going to be raided, they threw their butts into the cuckoo clock.

Four hours passed before the cuckoo crawled out, looked around and said, "Man, dig those crazy cigarettes. What time is it?"

* * *

He was a rather under-sized freshman at his first college dance, but despite his smallness and bashfulness he was sure of himself in his own way. He walked over to a beautiful and over-sophisticated girl and said, "Pardon me, Miss, but may I have this dance?"

She looked down at his small size and lack of fraternity pin and said, "I'm sorry, but I never dance with a child!"

The freshman bowed deeply and said, "Oh, I'm sorry, I didn't know your condition."

* * *

A young man whose father had been hanged was filling out a college application. After the usual hereditary questions there was one asking the cause of the death of his parents. He thought awhile and finally put down this answer: "Mother died of pneumonia. Father was taking part in a public ceremony when the platform gave way."

* * *

A certain engineering student sent a sample of homemade beer to the Chem. Dept. to be analyzed. A few days later he received a report from Prof. Gustafson.

"Dear Sir: Your horse has diabetes."

* * *

Prof. Pietenpol: If, in going down this incline, I gain four feet per second, what will be my condition after 25 seconds?

Smart sophomore: You'll be a centipede.

PHOTOGRAPHY AT WORK No. 4 in a Kodak series

Photography helps a New Steel Mill roll into action

Fairless Works, U. S. Steel's new Eastern Seaboard mill, is now starting operations—and growing—at the same time. And camera and film play their parts in both.

. . . to help locate ore, plot transportation, lay out plants, control quality, improve production, U. S. Steel puts Photography to work.

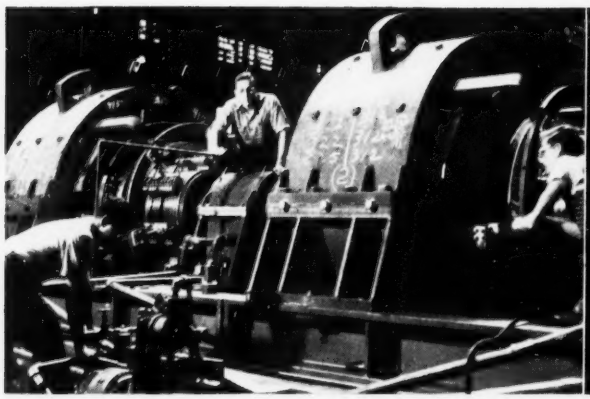
From ore through research and production, Photography is one of Steel's important operation tools. It helped locate and appraise the new Venezuelan Cerro Bolivar deposits which sparked this great new seaboard mill. It helped chart the ore's course to the sea—helped plan the plant and keeps a running record of its growth. And day after day it's at work in the research lab improving steel metallurgy, and on the production line controlling quality.

Countless numbers of America's varied industries, large and small, use photography in many ways to save time, speed accomplishment, increase production, and cut costs.

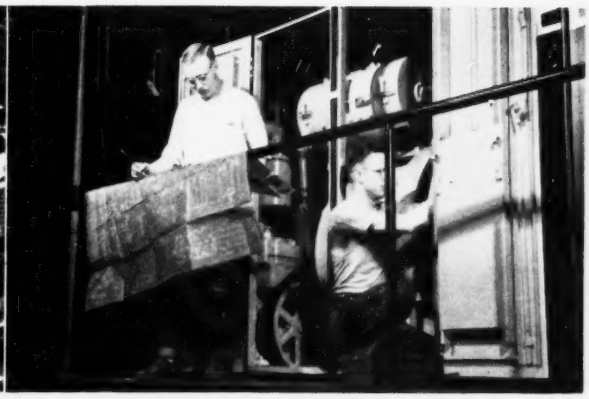
In fact, so many new applications of photography are being found, that many well-qualified graduates in the physical sciences and in engineering have been led to find positions with the Eastman Kodak Company. Returning servicemen, too, have found new opportunity here.

If you are interested, write to Business and Technical Personnel Dept., Eastman Kodak Company, Rochester 4, N.Y.

Eastman Kodak Company
Rochester 4, New York



CHARLES SNYDER, R.P.I., (center) adjusting 5250 triple-unit d-c mill motor for use in a steel mill.



Engineers RICHARD RENK, IOWA STATE, (left) and ALLEN FRINK, CATHOLIC UNIV., make last-minute check on 1600-hp diesel-electric switcher before it is moved to test track.

THEY'RE "GOING PLACES" AT GENERAL ELECTRIC

Like these young men pictured here, hundreds of scientists, engineers, chemists, physicists and other college graduates are "getting ahead" fast at General Electric . . . . and they are working on projects with the assurance that their contributions are meaningful and important.

They are moving up rapidly because at General Electric a world of opportunity awaits the college man of today—a world limited only by his own ability and interest. The variety of General Electric products and the diversity of the Company's operations provide virtually unlimited fields of opportunity and corresponding rewards, both materially and in terms of personal satisfaction to young men who begin a G-E career.

New developments—in silicones, electronics, semi-conductors, gas turbines, atomic power, and others—springing from G-E research and engineering, are creating exciting new opportunities, and are giving college graduates the chance of finding satisfying, rewarding work.

And by placing prime importance on the development of talent and skill, developed through G-E training programs and broadened through rotational job programs, and by providing incentives for creative minds, General Electric is hurrying young men into success in an industry that is devoted to serving all men through the ever-increasing and ever-widening uses for electricity, man's greatest servant.

If you are interested in building a career with General Electric see your college placement director for the date of the next visit of the General Electric representative on your campus. Meanwhile, for further information on opportunities with General Electric write to College Editor, Dept. 2-123, General Electric Company, Schenectady 5, New York.

Test engineers E. K. VON FANGE, U. OF NEB., (left) and R. E. LOVE, U. OF TEXAS, work on stacker and stapler built by them for homework project.

Physicist ROGER DEWES, BROOKLYN POLY., working with scintillation counter in G.E.'s Engineering Laboratory.

ANTHONY TERZANO, PRATT INSTITUTE, checks connections on direct-current rectifier which charges 7,500,000-volt impulse generator in G.E.'s new High-voltage Laboratory.

GENERAL ELECTRIC